Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

APRIL ★ 1945

INDUSTRIAL
COMMERCIAL
AND LARGE
BUILDINGS

e 207 — *Journal Section of the American Society of Heating and Ventilating Engineers*

IN THIS ISSUE: Operation and Maintenance of Industrial Air Conditioning . . . Pressure Drop Calculations . . . Steam Trap Testing Aids Heating Efficiency . . . many others.

CONTENTS . . PAGE 69

TOUGH CUSTOMER

The world's toughest customer . . . that's the United States Navy. Tough in battle — equally tough in buying equipment for fighting ships and men.

Navy specifications are the strictest ever written. Navy inspectors see that every piece of equipment meets or exceeds those specifications. Navy delivery schedules must be met to the minute.

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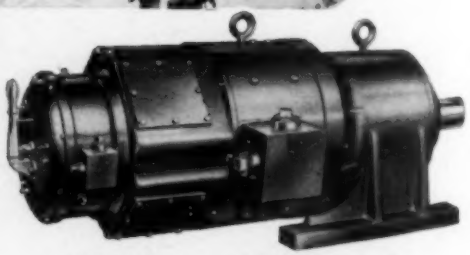

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STAR MOTORS

POWER PACKAGED AS YOU NEED IT

SAVE FUEL, GOVERNMENT WARNS, TO AVERT TROUBLE

DECREASING COAL production throughout 1945 will make it imperative for industrial plants to reduce coal consumption to a minimum, according to the Solid Fuels Administration for War. Every effort will be made to give war essential industry the amount of coal it actually needs, but success will depend upon the cooperation of industry.

It will not be possible for every plant to get the particular type of coal it would use in normal times, says the SFAW. A larger proportion than ever of these coals will have to be earmarked for byproduct coke ovens, for steel manufacture, and other essential war uses. To do this, shipments for domestic heating will probably have to be further drastically reduced but industry will also have to bear an increasing share of the burden.

Many plants are already having to use coal of substandard quality and the necessity will apply to more and more plants. Less and poorer coal, therefore, will require that these plants give No. 1 attention to conservation and utilization. Plant engineers are urged to re-study their firing methods in order to get maximum efficiency from the fuel they will be forced to use, and to cooperate closely with the National Fuel Efficiency Section of the Bureau of Mines.

The following factors underlie the situation, according to the SFAW:

1) The deficit in bituminous coal for the coal year ending March 31, 1945, approximated 16 million tons. While the yearly overall production and consumption were fairly well balanced through December 1944, there was a critical shortage in the types of coal essential to steel and other vital war industries for which substitutes could not be used. Therefore, the apparent statistical balance did not give a realistic view of the actual conditions. With the heavy burning season and continued heavy war needs, the gap between consumption and production was widened rapidly during January and February. Heavy snowfalls and transportation difficulties made the situation even more serious.

2) Due to increasing losses in manpower in the mines, because of the military replacement schedules, estimated production of bituminous coal for 1945 will be only approximately 570 million tons against estimated requirements of around 620 million tons—a deficit of some 50 million tons. Of this deficit we cannot reasonably hope to squeeze over 20 million tons out of stocks, leaving a net deficit of around 30 million tons. This shortage will have to be met by conservation by both industry and domestic users.

3) Stockpiles as of January 1 averaged only 32 days' supply. By April 1 they were down to about 22 days' supply. Stockpiles in the critical coals have, throughout the winter, been well below the margin of safety. Over a dozen steel plants, at one time, had less than a 10 days' supply and many others were precariously low.

4) Any belief that the end of the war in Europe will solve the problem should be wholly discounted, says the SFAW. Present plans for war production call for continuing heavy schedules and, though requirements for coal may be somewhat reduced, they will still be very much heavier than the ability of the mines to meet them.

The SFAW recently issued the following suggestions for conserving fuel:

How Plant Engineers Can Practice Fuel Efficiency

To prevent waste in firing boilers with coal, it is well for plant engineers and firemen to check over their equipment daily. Responsible persons should make certain that heating surfaces are kept clean both inside and outside. Strict attention should be given to the conditioning of boiler feedwater and to the efficiency of combustion, to make sure that the fuel is being used effectively.

Inspections and tests should be made at frequent and regular intervals of steam traps and air valves in building heating systems, and temperatures should be controlled in the various plant units. One building may have too much heat and another not enough. Such a condition frequently results in "driving" boiler capacity so hard to heat the cooler building that the other is overheated and the windows are thrown open, thus wasting heat and coal.

In many cases, manufacturing schedules can be planned in such a manner as to stagger the starting of machinery in the morning. This avoids heavy loads that might overburden the capacity of the boiler plant, at the same time using fuel and steam only as needed. Providing steam for idle plant machinery, while other machinery is at work, is a source of waste.

Save Coal by Heat Controls

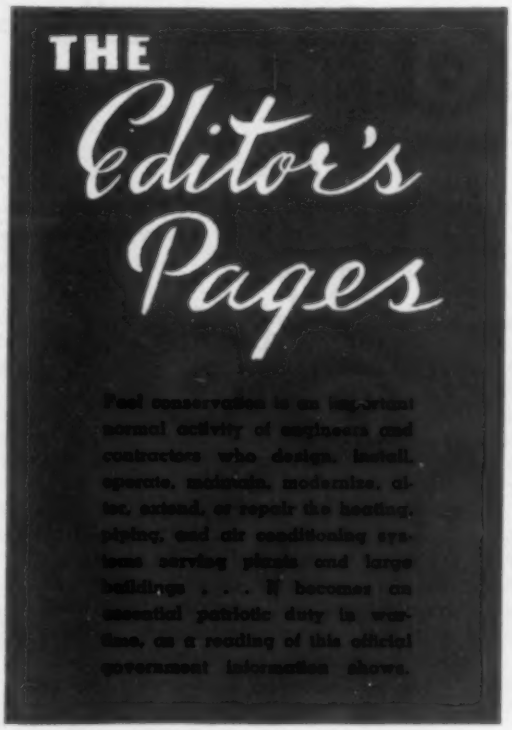
Automatic heat controls are very useful, and in most cases the cost of installation is justified by the saving in fuel that results. These controls generally are of two types: First, automatic controls that operate boiler units, regulating steam pressure and the flow of fuel and combustion air, and second, automatic controls that regulate the distribution of heat to plant buildings and processes.

Boiler efficiency and the successful utilization of heat are governed by a number of factors. All of them have a direct bearing upon the use of coal. These include design of steam generating units, operating skill, load distribution, combustion control, adequate maintenance, and fuel adaptability. The last is important now because of the widespread necessity for firing with such alternative coals as can be made available after the needs of steel and merchant coke plants for the higher grade coals are satisfied.

Most plants, naturally, have some kind of control over temperatures, but many of them could profitably have more. But this scientific and complicated problem requires the advice of heat control experts, such as those taking part in the National Fuel Efficiency Program. Controls that take into consideration solar radiation and wind direction, the fuel experts say, can save money for a large building heating plant. Other controls, built within the smokestack, also may be highly significant and contribute measurably to fuel savings.

An engineer should know relatively how much air enters the boiler, the rate of combustion, draft loss through the boiler, air pressure under the grates, and temperature of gases leaving the boiler. This information can be provided by gages which reveal how the plant is performing.

A good example of results obtained by temperature control installations, according to the recent report of an



industry committee, is the experience of a Detroit company which furnishes steam for many of its customers. Between 1935 and 1941, the report stated, 59 temperature control systems were installed by the steam customers on the recommendation of utilization engineers. Of the 45 which made records available, 35 made a reduction in steam consumption averaging 14 per cent, while 10 others showed an increase in steam consumption.

Conserving Coal by Insulating

The most successful industrial plants are equipped with boilers, furnaces and distribution systems designed to be as nearly "heat-leak-proof" as possible. Such designs include adequate insulation to prevent the escape of heat and the resultant decrease in fuel efficiency, which adds to the total cost of coal.

A national manufacturer's organization cites, as an outstanding example of how practical plant management can save money, the case of a plant which was losing 2,796,192,000 Btu per year through failure to take advantage of heat saving improvements. The plant had a boiler which operated at a steam pressure of 120 psi at a temperature of 350 F, and had an exposed surface of 400 sq ft. By applying a 2 in. thickness of insulation the plant eliminated 90 per cent of the Btu loss.

Tests made at plants using insulation show that if a 3 in. steam pipe with a surface temperature of 392 F is adequately insulated for a length of 200 ft, a saving may be made of 9 lb per hr of coal or a potential saving of 35 tons a year. If the same pipe had a surface temperature of 680 F, the corresponding potential saving would be about 70 tons per year, since the higher temperature and added thicknesses of insulation used reduce still further the heat loss. In addition to saving coal, the insulation of steam lines increases plant capacity.

Automatic Stokers Save Coal

Wherever boilers are fired with automatic stoking apparatus, faulty distribution of coal in a furnace resulting from manual firing can be reduced materially with beneficial results. Stoker firing assures a more even consumption rate, which can be only approximated by the best of hand firing methods.

Plant engineers and firemen who use stokers should become thoroughly familiar with their equipment by careful study of instructions that are based on the manufacturer's tests. When inspecting stokers at regular intervals, particular attention should be given to parts that are in the furnace, where they are subjected to intense heat.

Special attention also should be given to any automatic air control, since that control involves minute adjustment of both draft regulators and stoker fans. These must be set to maintain a fuel bed of the required thickness, after the coal feeding apparatus has been adjusted in accordance with the load.

In using automatic stokers, the rate of coal feed is of primary importance. Different grades of coal require different rates of feed and when new grades are used the stoker should be readjusted accordingly.

Other Conservation Measures

There are other sound methods of preventing heat leaks, such as properly equipping buildings with storm windows and doors, and with weather-stripping, replacing broken glass, chinking up the cracks in buildings around doors and windows, discontinuing the heating of space where heat is not absolutely necessary, etc.

THE Editor's Pages

While the boiler room represents one of the best opportunities for preventing heat losses and wastes, by no means is it the only place to expect a saving. Besides keeping the boilers and fuel burning equipment in good mechanical operating condition, which includes keeping the fire and water sides of the boiler clean, maintaining proper adjustment of firing equipment and chimney draft and operating them properly at all times, there are many other places throughout the entire building or plant where losses of heat, steam, or hot water can be eliminated.

The boiler auxiliaries, such as instruments and controls, pumps, valves and traps, and heat exchange equipment, must all receive proper attention periodically if heat dissipation is to be avoided.

In addition, utilization and distribution equipment present dozens of points where savings can be accomplished, if an organized method of checking is followed. Properly packed valves and joints, and tight-closing hot water valves are definite "musts" in the efficient and economically operated plant.

The use of exhaust steam is of vital importance, and there are many ways of utilizing it. A few of the important ones are feedwater heating, service water heating, process heating, and space heating. Process equipment heat losses, electrical energy losses, and compressed air leaks are always in the foreground of the minds of those seeking the location and prevention of heat energy losses.

Employees should be educated as to the necessity for saving fuel. Their cooperation must be enlisted to avoid such practices as wasting hot water, leaving doors and windows open when it is not necessary, permitting rooms to become overheated, etc.

EPH. A. TYLER SUPERVISES BANK PROPERTIES

Eph. A. Tyler, member of HPAC's board of consulting and contributing editors, has moved his office from Saint Paul to Minneapolis, where he is manager of the newly established building department of the First Service Corp.

Mr. Tyler has been rental manager of the First National Bank of Saint Paul which, with the First National Bank of Minneapolis and 70 other banks in the ninth Federal Reserve district, is owned by the First Bank Stock Corp. The supervisory and service unit of the First Bank Stock Corp. is the First Service Corp.

The building department of the First Service Corp. has general supervision of all the properties in the First Bank Stock Corp., including the direct management of all new construction work and equipment of the bank and office buildings.

ISSUES SUPPLEMENT TO PRESSURE PIPING CODE

The American Standards Association, 70 E. 45th St., New York 17, N. Y., has issued a supplement to the Code for Pressure Piping, B31.1a-1944, which may be obtained for 10 cents from the ASA, according to a report in its journal, Industrial Standardization.

The supplement provides that all bolts or bolt studs and accompanying nuts intended for high temperature service should be threaded in accordance with the American War Standard for Straight Screw Threads for High Temperature Bolting, B1.4-1942.

For pit-cast cast iron pipe the supplement states that reference should be made to the American Standard Specifications for Cast Iron Pit Cast Pipe for Water or Other Liquids, ASTM A 44-41; ASA A21.2-1939, rather than to the American Water Works Association specifications. References to cast iron bell and spigot fittings should include the AWWA and American Gas Association specifications. Specific references are listed for sections 1, 2, and 3 of the code.

The supplement also points out changes in the following parts of section 3 of the Code for Pressure Piping: table 21; paragraph 325 (c); page 91, footnote; table 27, footnote 2; and table 34, section 4.

Heating Piping & Air Conditioning

with which is merged the Aerologist

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CONTENTS THIS MONTH

April 1945 Vol. 17, No. 4

The Editor's Pages (news and comment) ..... front section 65

Using the Velocity Head Concept in Pressure Drop Calculations, by C. E. Lapple 179

What's This Radiant Heating?, by George B. Coffey 183

Automatic Coal Conveyors Solve a Heating Problem, by Edward Klamt 186

Air Conditioning a Mezzanine Tool and Gage Inspection Room, by Walter P. Wilkins 188

"Open for Discussion" 191

What's Holding Back the Heat Pump?, by R. U. Berry 191

Central Refrigeration for Air Conditioning, by A. C. Buensod and R. W. Waterfill 191

Air Conditioning Results Depend on Good Design, by O. W. Ott 194

Sam Lewis' Page—How to Guard Against Contamination When Heating Process Tanks by Steam Injection 196

Practical Pointers on Operation, Maintenance, Repair, Alteration, Extension . 197

Organizing Operation and Maintenance of Industrial Air Conditioning Systems, by R. D. Tutt 197

Regular Testing of Steam Traps Aids Wartime Heating Efficiency, by L. W. Mauger 200

Protecting Workers from Toxic Vapors 202

Operation and Maintenance of Steam Piping at an Institution, by George Holman 203

Equipment Developments ..... back section 159

Recent Trade Literature ..... back section 170

WPB . . . OPA . . . PAW . . . Etc. (new government orders) ..... back section 182

New Books & Reports ..... back section 188

Meetings & Conventions ..... back section 190

Index to Advertisers ..... back section 194

Journal Section of the American Society of Heating and Ventilating Engineers

The Influence of Heat Capacity of Walls on Interior Thermal Conditions and Heat Economy, by C.-E. A. Winslow, L. P. Herrington, and R. J. Lorenzi .. 207

Committee on Research Annual Report 1944 215

Conference on Industrial Ventilation 223

The Guide 1945—23rd Edition 224

Members on Active Duty 225

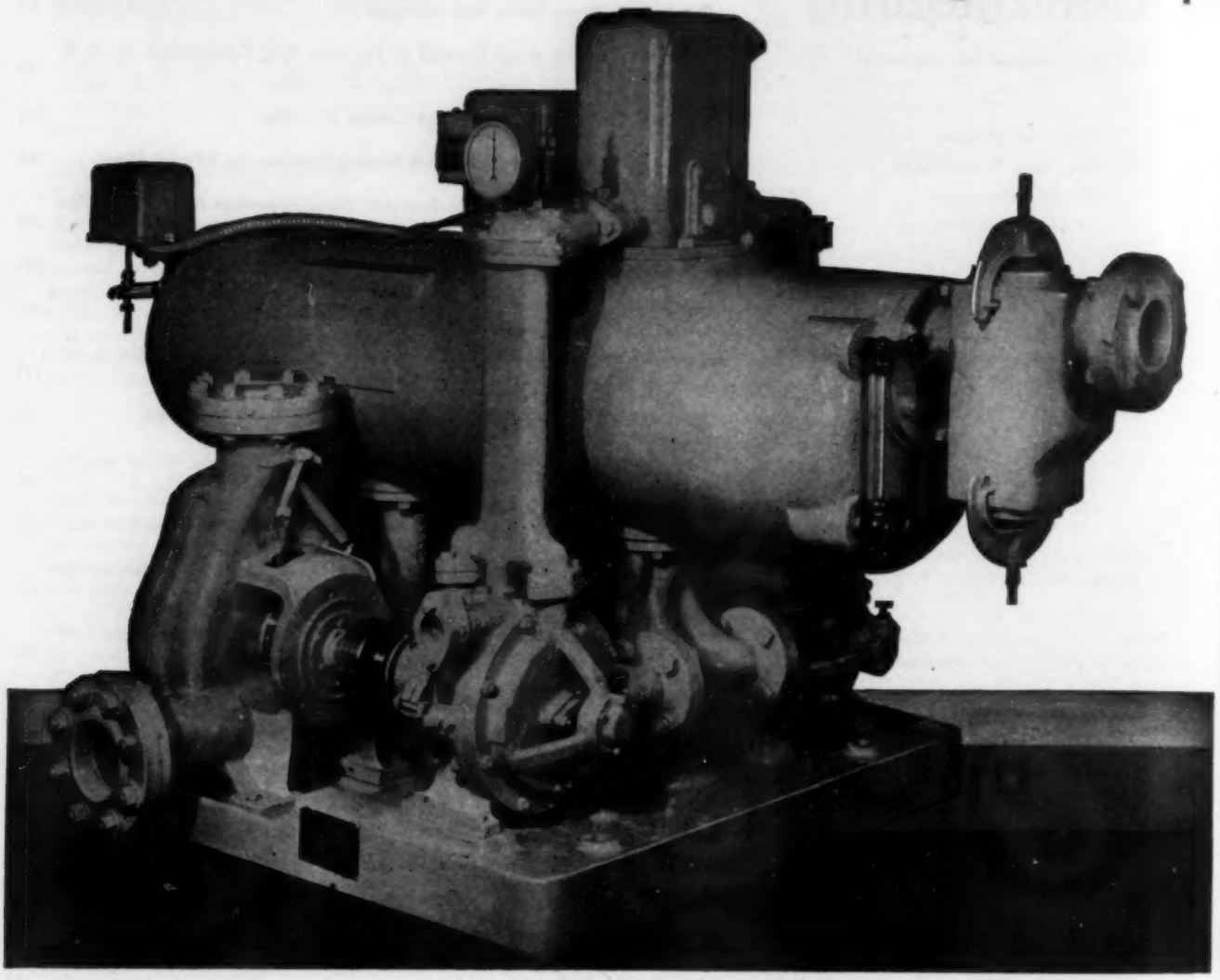
Summary of Local Chapter Meetings 228

Candidates for Membership 232

Candidates Elected 234

Officers, Council, and Committees 235

Where Heat Must Not Fail— Install this SAFE Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is entirely independent of electric current failure, and continues to operate as long as there is steam in the system.

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THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

Using the Velocity Head Concept in

PRESSURE DROP CALCULATIONS

By C. E. Lapple*

IN THE design of pipe lines, ventilation systems, and process equipment, it becomes necessary to estimate the overall pressure drop in order to specify the required fan, pump, blower, or compressor capacity. It may also be necessary to design adequate metering elements. In the operation of equipment, pressure drop estimates are often essential for purposes of locating possible plugged or corroded lines, checking on process performance, or determining "bottlenecks" for proposed capacity increases.

Conventional methods of calculation in the form of friction factors, orifice coefficients, or equivalent lengths of fittings and valves have been developed for many types of conduits and equipment commonly employed. Frequently, however, equipment is encountered for which no specific data are available, and it becomes necessary for the engineer, designer, or operator to be able to make a reasonable estimate. In order to make such estimates it is necessary to have available a clear physical concept of the mechanism that controls the pressure drop in a fluid. Fluid flow is often regarded as a complex phenomenon that can only be represented by intricate mathematical expressions which will yield the correct answer if proper substitutions and arithmetical solutions are applied. As a result, designers have developed "rules of thumb" as a guide or for purposes of checking the order of magnitude of such calculations. Such rules have been passed along and are accepted by some as approximate representations of practical experience and frowned upon by others who question their general validity. It is the purpose of this paper to furnish an insight into fluid flow mechanisms which will enable visualizing frictional or pressure drop processes and incorporating a physical conception into pressure drop equations, as well as to provide simplified equations for rapid estimating, for checking of more accurate calculations, or for use in the field where standard reference sources are not available.

DESIGN OF pipe lines, process equipment, ventilation systems, etc., requires estimation of pressure drops in order to specify the required pump, compressor, fan, or blower capacities. Pressure drop estimates are often necessary, too, in the operation of equipment for purposes of locating possible plugged or corroded lines, checking process performance, or determining bottlenecks for proposed capacity increases. The article of which this is the first part is intended as a guide to a physical conception or visualization of otherwise seemingly complex fluid flow phenomena. The approximations presented will be found to be entirely adequate for many purposes, and an attempt has been made by the author to point out their limits of accuracy.

The flow of a fluid may, in general, partake of one or both of two types of flow—streamline and turbulent. In streamline flow, adjacent layers of moving fluid slip over each other with no mixing or interchange of portions of fluid from one layer to the next. Turbulent flow is characterized by an eddying of the fluid within itself in addition to a specific motion of the fluid body in a given direction. In turbulent flow, adjacent layers do not shear smoothly over each other, but are continuously exchanging portions of fluid. In streamline flow, frictional losses are due directly to shearing between adjacent layers of fluid. In turbulent flow, frictional losses are due to random shearing and impact of fluid exchanged between the layers. Turbulent flow ensues when inertia forces predominate over the viscous forces within the fluid.

The nature of flow of a fluid is consequently characterized by the Reynolds number, Re, which represents a measure of the ratio of inertia to viscous forces. When this ratio exceeds a certain critical value (approximately 2000 for flow in straight round pipes), turbulent flow ensues, whereas for lower values the flow is streamline. Over 98 per cent of all fluid flow problems in practice are concerned with turbulent flow.

The velocity head concept visualizes pressure drop or friction loss in terms of the kinetic energy of the fluid and is thus valid where inertia forces or changes in kinetic energy of the fluid are concerned. Consequently, its utility is limited to turbulent flow conditions. The velocity head concept is not novel and has long been in actual use, particularly by ventilating engineers. Unfortunately, it is not adequately described in the literature or in textbooks, and its full physical significance and utility are not widely appreciated.

*Engineering Dept., Chemical Engineering and Metallurgical Laboratory, Experimental Station, E. I. du Pont de Nemours & Co., Inc.

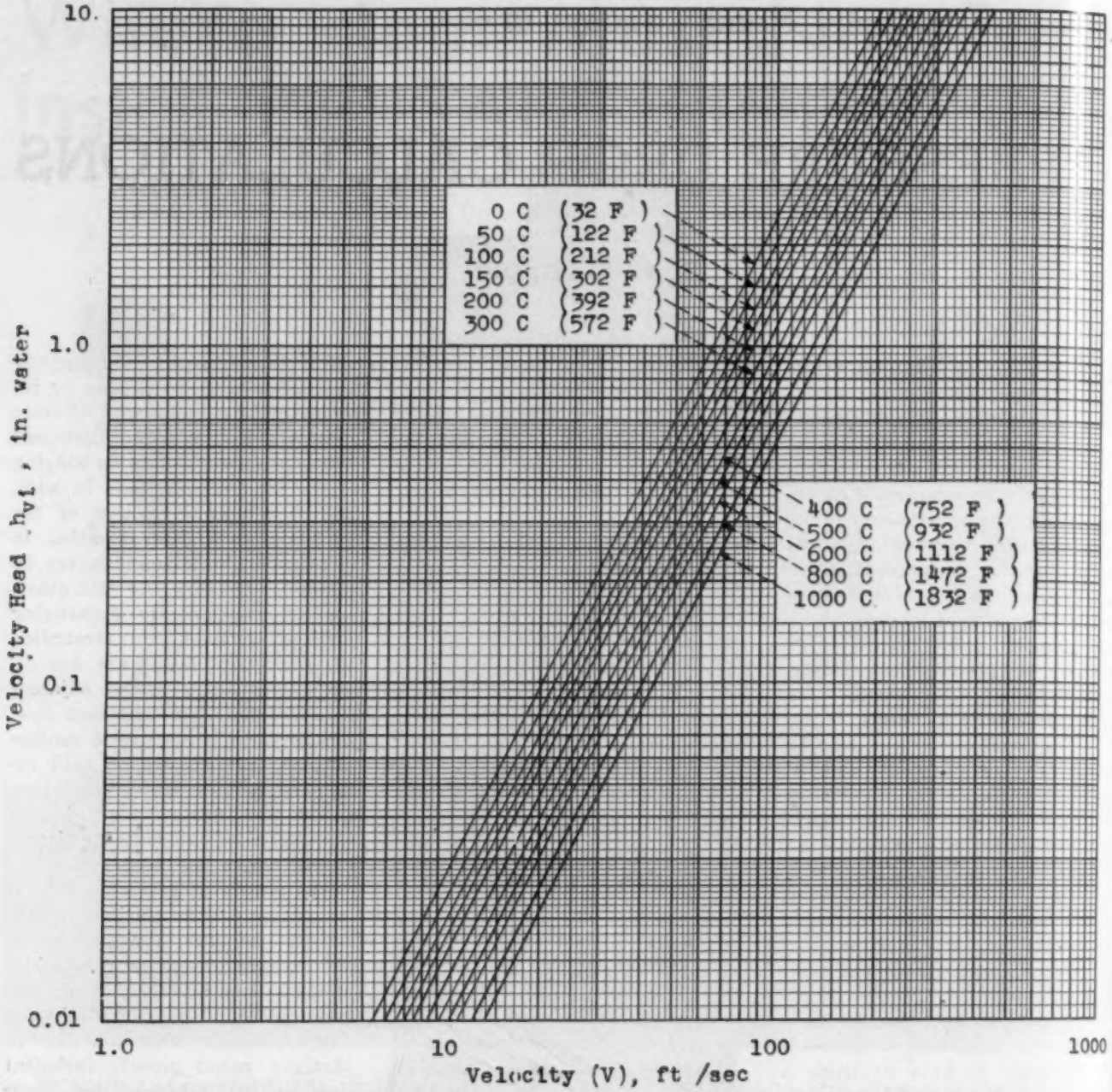


Fig. 1—Velocity head plot for air at one atmosphere pressure. (Note: For other pressures or gases, multiply h_{v1} by the absolute pressure, in atmospheres, and by the quantity, molecular weight ÷ 29)

Nomenclature

D = Inside diameter of circular pipe, ft;
D_c = Clearance between tubes in a tube bank, ft;
D_p = Diameter of granular particle, ft;
E_v = Kinetic energy of fluid (ft-lb force)/(lb mass);
F = Friction loss (lb force)/(sq ft)†
g_c = Conversion factor, 32.17 (lb mass/lb force) (ft/sec²);
g_L = Local acceleration due to gravity (ft/sec)/(sec);
h_v = Velocity head, ft of fluid flowing;
h_{v1} = Velocity head, in. of water;
p = Fluid pressure, (lb force)/(sq ft);
p_v = Velocity head (lb force)/(sq ft);
p_{v1} = Velocity head (lb force)/(sq in.);
Δp = Pressure drop (lb force)/(sq ft);
Re = Reynolds number, dimensionless = $(DV\rho/\mu)$ for flow through pipes, orifices, nozzles, or venturis; $(D_c V_{max}\rho/\mu)$ for flow across tube banks; $(D_p V\rho/\mu)$ for flow through beds of granular solids;
V = Average fluid velocity (ft/sec);
V_{max} = Maximum average fluid velocity in flow across tube banks (ft/sec);
Z = Elevation of fluid above arbitrary datum plane, ft;
ρ = Fluid density (lb mass)/(cu ft);
μ = Fluid viscosity (lb mass)/(ft) (sec) = centipoises ÷ 1488.

†Friction loss is often defined as an energy loss per unit mass of fluid, having the dimensions (ft-lb force)/(lb mass). This definition of friction loss is equivalent to the quotient F/ρ.

Definition of Velocity Head

A fluid flowing with a velocity, V, has associated with each pound of fluid a certain kinetic energy defined by

$$E_v = (V^2/2g_c) \quad \text{.....[1]}$$

Since pressure is a form of potential energy of the fluid, this kinetic energy can be expressed as an equivalent pressure differential which is known as the velocity head. For any fluid, the following alternate equations express this equivalent pressure or velocity head in various units:

$$p_v = (\rho V^2/2g_c) \quad \text{.....[2]}$$
$$p_{v1} = (\rho V^2/288g_c) \quad \text{.....[3]}$$
$$h_v = (V^2/2g_L) = (V^2/2g_c)(g_c/g_L) \quad \text{.....[4]}$$
$$h_{v1} = 0.00300\ \rho V^2 \quad \text{.....[5]}$$

The ratio (g_c/g_L) in Equation 4 is numerically equal to unity and is introduced only to maintain the equation correct dimensionally.* The term "velocity head" derives its name from the form given by Equation 4, which represents the fluid head equivalent to the kinetic energy per unit mass of fluid. It may also be interpreted as the height from which the fluid must fall to attain a velocity V in a vacuum.

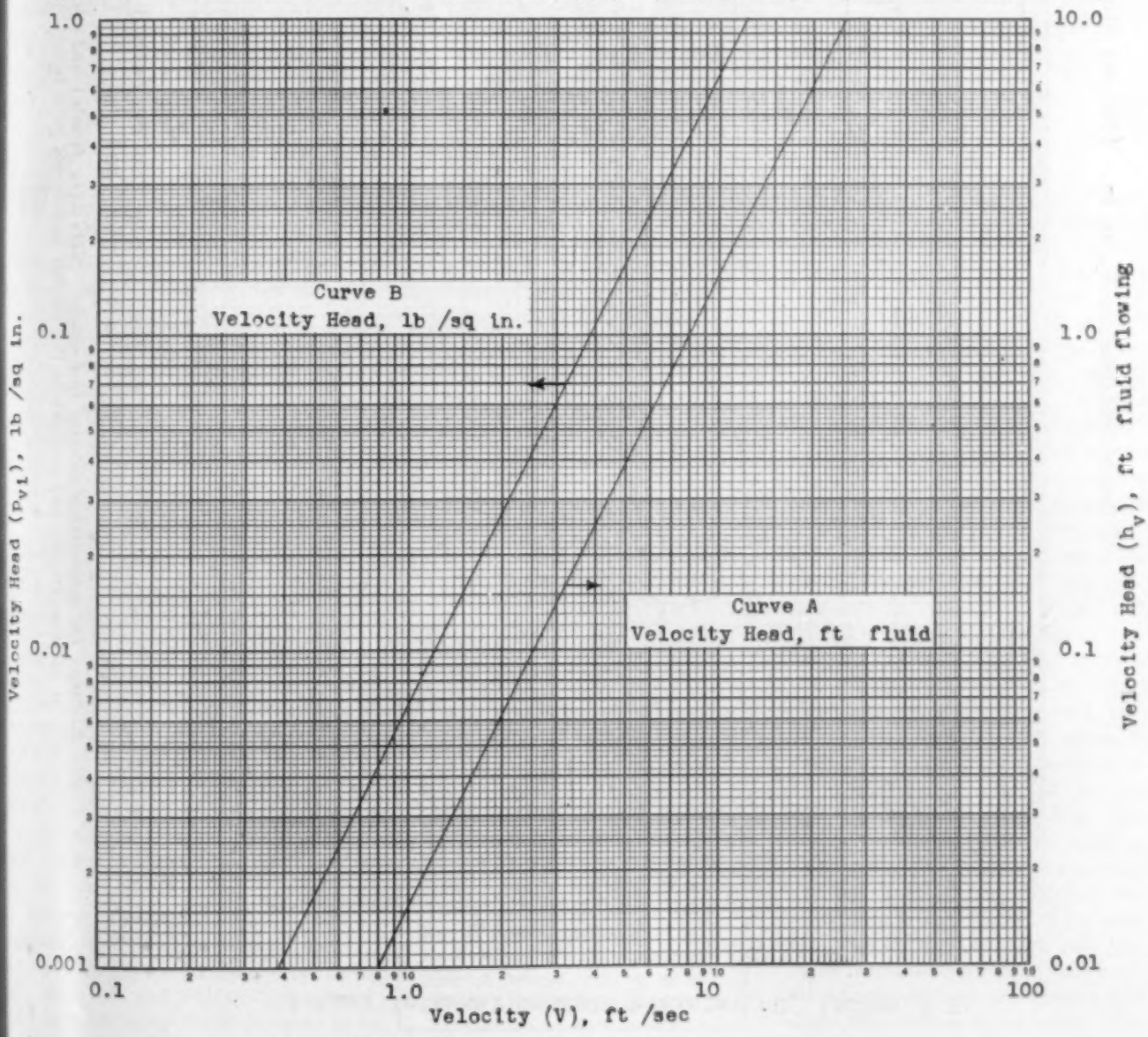
Figs. 1 and 2 give a plot of the velocity head for air and water, respectively, flowing at various temperatures and velocities. In Fig. 3 is given a plot for converting gal/min (Curve A) or cu ft/min (Curve B) to linear velocity for the case of flow in circular pipe. To obtain the velocity corresponding to a given volumetric flow rate in a given size pipe, multiply the volumetric flow rate by the abscissa corresponding to the pipe diameter. It should be noted that cu ft/min refers to the actual volumetric rate

*See Perry, J. H., Chemical Engineers' Handbook, 2nd ed., section 6, p. 809, New York, McGraw-Hill Book Co., 1941.

Table 1—Approximate values of the velocity head

Fluid	Fluid Velocity ft/sec	Velocity Head
Air (1 atm, 125 F)	50	½ in. water
	70	1 in. water
	100	2 in. water
Water	4	0.1 lb/sq in.
Any Fluid	8	1.0 ft fluid

Fig. 2—Velocity head plot for water at temperature of 4 C. (Note: Curve A—holds for any fluid as well as for water. Curve B—for other liquids or temperatures multiply p_{v1} by the specific gravity referred to water at 4 C)



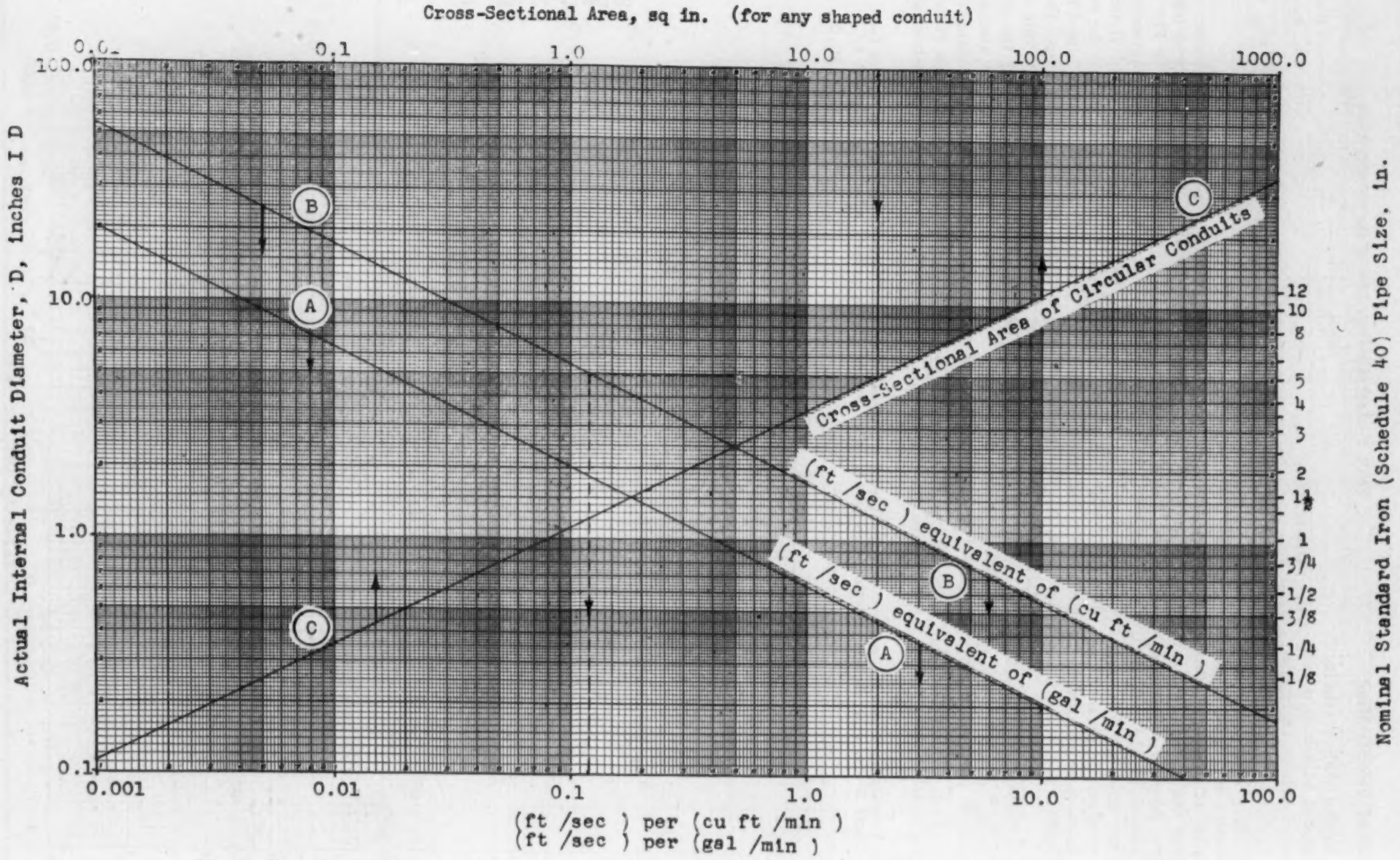


Fig. 3—Chart for determining velocity in conduits. Note: (cu ft/min) and (ft/sec) refer to the actual flow rate and velocity at the temperature and pressure in the conduit and do not refer to conditions at any standard temperature or pressure

at the conditions existing in the pipe and should not be confused with volumetric rates referred to any standard temperature or pressure conditions. For any shaped pipe, a plot (Curve *C*) is also given in Fig. 3 to indicate the equivalent circular pipe size having the same cross-sectional area. The dashed line shows the procedure for finding the ft/sec equivalent of cu ft/min for any shaped pipe having an area of 20 sq in.

Table 1 lists some values of the velocity head for specific fluids and velocities. These values are readily memorized and values of the velocity head for any other cases of fluid velocity or density can be readily obtained by mental cross-rationing. For other velocities, the corresponding velocity head is obtained by multiplying the value in the table by the square of the ratio of actual velocity to that given in the table. The velocity head is also directly proportional to fluid density. Thus, for other gases the value given in the table should be multiplied by the ratio of the actual molecular weight to that of air (29.0), as well as by the proper absolute pressure and temperature ratios to correct to other temperatures and pressures. For liquids, the value for water is to be multiplied by the specific gravity of the fluid. When expressed in terms of feet of fluid, of course, no density correction is needed. In practice, the unit, inches of water, is generally used in calculating pressure drops for low pressure gases; lb/sq in., for high pressure gases or liquids; and feet of fluid is often used for liquids.

Friction Loss and Pressure Drop

It is well to review at this point the distinction between friction loss and pressure drop. Pressure drop represents the difference in pressure of a fluid between two points in a system. This difference in pressure may be the result of a conversion of pressure energy into kinetic energy or potential energy resulting from a change in elevation, or it may be the result of a dissipation into heat by frictional losses. Friction loss represents only that portion of pressure energy lost as heat. The two items, pressure drop and friction loss, are related by Bernoulli's theorem, which applies where no mechanical work is done on or by the fluid,

$$\Delta p = (p_1 - p_2) = (\rho V_2^2/2g_c) - (\rho V_1^2/2g_c) + \rho(Z_2 - Z_1) + F \quad \ldots\ldots [6]$$

where subscripts 1 and 2 represent conditions at the upstream and downstream locations, respectively. Thus, for horizontal equipment with the same inlet and outlet area, the overall friction loss and the pressure drop are identical, if the fluid density does not undergo any appreciable change.

What's This Radiant Heating?

THAT'S A question almost anyone in the heating business is likely to have tossed at him these days, for there is a tremendous general interest in heating methods . . . and "radiant heating" comes in for no small part of this attention. George B. Coffey, of the A. M. Byers Co., answers the question here in brief, easy-to-read style. He's recently made a number of talks on the subject before various engineering and contractor groups, so his comments cover several of the questions which have come up at these meetings. You'll find this quick summary helpful when you're asked "What's this radiant heating?"

WHAT ARE THE specifications for the "perfect" heating system? While each person is privileged to stress one of a number of essential characteristics of the perfect system, there is substantial agreement that heating plant performance should follow some such ideal pattern as this:

1) Provide maximum human comfort.
2) Be automatic.
3) Be completely concealed.
4) Reduce air currents to a minimum.
5) Be clean.
6) Concentrate warmth where it is needed most—at the floor level.
7) Be competitive in original cost.
8) Be economical in fuel consumption and maintenance.

Radiant heating comes very close to meeting these specifications. The record of its performance has been attested by the occupants or owners of more than a thousand structures in this country where the system has been functioning for from one to 35 years.

Radiant heating is not a new method. The wealthy Romans heated their homes by building a fire in the basement and letting the gases and smoke rise to the floor, over to hollow walls, and up through the roof. There are evidences of radiant heating in England left by the Romans after their occupation of that country. The English engineers picked it up some 50 years ago and started experimenting with the idea. One of them invented a cast panel that he could hook up in series to meet his heat requirements. This is where the name "panel heating" comes from.

The oldest radiant heating job I know about in this country is one installed about 35 years ago in what is now Gary, Ind. At that time the village of Glen Park built a four room school, two stories high. The architect ran his heating pipes between the wood joists and produced such comfortable conditions that when the village was later incorporated into Gary, the teachers in the city schools vied with one another to teach in that school. The superintendent came to the conclusion that that would be the ideal way to heat schools.

Fireproof schools then came to the front but nobody seemed to know how to run the pipes in concrete; therefore, the idea was dropped. It was not until seven or eight years ago that any large scale use of this type of heating was started in this country. The cause for this revived interest was that some architects wanted to build structures without basements, and their experiences had taught them

that concrete floors on the ground were hard to keep warm.

Almost everyone has had some experience with radiant heating, even if in crude and uncontrolled forms. For instance, you may have tried to warm the tile floor in your bathroom by placing hot water pipes under it, or by increasing the radiation from your fireplace by putting a reflector in back of the fire basket.

I know an architect who put a stainless steel sheet in the back of his fireplace. He had no method of measuring the increased heat that radiated into the room except that Fritzie, their dachshund, who formerly lay at the edge of the hearth, moved back about 10 ft. His conclusion was that because the dog moved 2½ times farther back, the radiation into the room had been increased by that amount.

Another instance would be that of the room directly over the boiler or furnace in a home. It is always the most comfortable room when cold weather arrives because the floor is warm and occupants have the benefit from the radiant rays emitted from that floor.

The Principle of Radiant Heating

Let us consider the principle of heating by radiant energy. The basic principle behind it is that if you take a heated object and a cold object and place them opposite one another, the heated one will lose heat to the colder one. This action will take place as long as the heated object can "see" the colder one, or just as long as a straight line can be drawn from the surface of one to the other. The rate of heat loss depends upon the size and temperature of the heated object in relation to the cold object.

Radiant energy leaves the hot surface in waves much as light leaves an electric bulb. These waves strike the colder surface and some are absorbed, while others are reflected to other cold surfaces. Those that are absorbed heat that surface, which in turn re-radiates its heat to the objects that are colder.

What is the reaction of the human body to such heating? We all have been told that the human body needs no external heat for its own comfort, that it manufactures its own heat even to the point of a surplus of some 400 Btu per hr. To be comfortable, then, we must get rid of that much heat every hour. The average body will lose about 50 per cent of that amount by radiation; the remainder is lost by convection and evaporation. This explains the paradox of the "cold 70" temperature with which everyone has had experience. In this case, the body is losing its heat by radiation to cold walls and objects faster than it can afford; therefore, it feels chilled. If we control the radiant heat loss from the body, then the air temperature becomes virtually insignificant. This is a fresh approach to achieving human comfort. Radiant heating does precisely that.

The author shows how floor coils for radiant heating are installed

The object of a radiant heating system is to warm a large room surface of sufficient size to give ample radiant energy for the room. This can and has been done in various ways. However, a majority of designers have elected to do it with wrought iron pipe coils imbedded in the floor or ceiling through which hot water is circulated. The majority of designers have elected to use floor coils instead of ceiling coils primarily because of simplicity and economy in installing. A ceiling coil will work just as well as a floor coil. Side wall coils are used only as auxiliaries to either of the other two.

Conventional Equipment Used

The same boilers, controls, circulators, and other equipment are used in radiant heating installations that are used in forced hot water systems. Some control manufacturers produce a eupatheoscope type of instrument that is operated by radiant energy waves. This is a black bulb instrument which absorbs the rays and, upon reaching a predetermined temperature, shuts the system off.

However, very good results are being obtained by the use of common air temperature thermostats, because the average temperature of the room surfaces and the air temperatures will closely follow each other. Lower thermostat settings are consistently very comfortable in radiant heated space. Occupants report 62 to 68 F as "very suitable."

The installation cost of a radiant heating system, from all the figures we have been able to accumulate, is about the same as that for a good forced water system, averaging from 6 to 9 per cent of the total cost of the project.

From composite records available on operating costs, savings in fuel consumption of from 15 to 30 per cent with radiant heating systems are common, and the bulk of them seem to be closer to the 30 per cent mark. The surface of the skin has a temperature of approximately 83 F, so the maximum floor surface temperature in a floor installation is held near that temperature. An 85 F floor does not give the hand, when placed on it, any sensation of heat or cold. This is, of course, the maximum temperature —the one for zero weather. In milder weather the floor temperature is somewhat lower.

Floor coverings, it has been determined, have little effect on the system. If anything, reports point to an improved comfort condition with carpeting on the floor, the theory being that each wool fiber acts as a fin for a jumping off place for the heat waves, whereas a smooth floor does not have these "springboards."

Any competent heating engineer can very easily design and lay out a radiant heating installation that will produce comfort. By using the pipe coils, we have a different technique in heating and we have opened a new field of exploration for the technicians. Some of their reports have a tendency to confuse the average person to the point that he is afraid to try radiant heating. To illustrate, you and I do not care what happens when we turn on the radio as long as we get clear reception of the program selected. It is the same with radiant heating. I have seen jobs that apparently have had no rhyme or reason to their design and yet they are producing comfortable conditions. With only a slight bit of engineering they would probably be more efficient in operation but no more comfortable. The point to remember is that the system operates at medium water temperatures, and by merely raising or lowering that temperature a few degrees almost any design errors may be corrected.

Snow Melting

As a byproduct of this type of heating there has been mounting activity in using this construction for melting of snow from thoroughfares. Several industrial concerns have placed hot water pipes in the walkways and open truck ramps around their plants, and similar installations have been made under driveways at private residences. It seems altogether possible that this application may become commonplace in the northern part of this country after the war—at filling stations, freight and passenger depots, transportation terminals, beneath the runways at airports, even under the sidewalks in downtown areas.

THOSE BURIED CONVECTORS

THE EDITOR—

About those plastered-over convectors described by Sam Lewis on page 144 of the March Heating, Piping & Air Conditioning, you know, of course, what happened.

The owners' man wanted heat there and, obstruction of floor space being a consideration, the installer—to not have to call him contractor or steamfitter — recommended convectors, as a matter of routine. Then he found he could get no cabinets (you just go out and try to find a single one). So, sez he, we fix that later. So he went and left it to the plasterer, probably telling him, "Look, Tony, put some metal caning in the top and the bottom." That guy nails wire lath over the whole thing, endeavoring to leave it unplastered top and bottom, does not succeed and finally he has it all closed up—to hellawidda disa chopp.

Thus I reconstruct the crime after much experience in the business of steamfitting.—WALTER OTTO, W. Otto Bros. Maintenance Co.

* *

The editors of Heating, Piping & Air Conditioning will welcome your comments on articles published in these pages, or on any subject pertinent to the design, installation, operation, maintenance, etc., of heating, piping, or air conditioning systems in plants or large buildings. Which article this month most interests you? Do you disagree with any of the author's statements? What additional information would you like to have? Our address is 6 N. Michigan Ave., Chicago 2, Ill.

AUTOMATIC COAL CONVEYORS SOLVE A HEATING PROBLEM

EDWARD KLAMT, ARCHITECT AND ENGINEER, DESCRIBES THE COAL CONVEYING AND STOKER INSTALLATION WHICH SERVES THE THREE HEATING BOILERS IN A UNION HALL

A PROBLEM encountered in critical labor areas, especially with smaller heating and power boiler plants, has been to secure boiler room attendants. A case in point is that of a large union hall—the Ashland Boulevard Auditorium, in Chicago, which is owned and operated by Division 241 of the Amalgamated Association of Street, Electric Railway and Motor Coach Employes of America. Previous to the 1944-45 heating season it was impossible to find help capable of efficiently handfiring the downdraft boilers (of which there are three, one of which is used as a standby).

This situation suggested the use of automatic firing devices, in connection with automatic coal feeding devices. Another consideration that favored the use of automatic heat was the character of the heating load. The auditorium has three stories and basement. The auditorium itself occupies all the third floor, including a balcony, containing 1,000,000 cu ft; and with handfiring it had been difficult to bring the hall up to comfortable temperature quickly. The second floor contains a number of lodge and meeting rooms and offices. The first floor is used principally by the state automobile registration bureau. In the basement are 30 bowling alleys. It can be readily seen, therefore, that the heating problem calls for the maximum of flexibility. The connected load is approximately 28,000 sq ft of radiation, with an additional 8000 sq ft for an air washer system and 25 per cent line loss.

The load problem and part of the labor problem was solved by the installation of three industrial, open hopper type bituminous stokers in the 15,000 sq ft downdraft boilers, which required no extensive alteration. Each stoker has a capacity of 500 lb per hr of coal. The steam system is of the overhead downfeed, single pipe type. A pressurestat is used as the high limit for the stokers, and an aquastat on the return line functions as the low limit control. One of the stokers is operated during the summer to supply hot water, with an aquastat acting as a holdfire control.

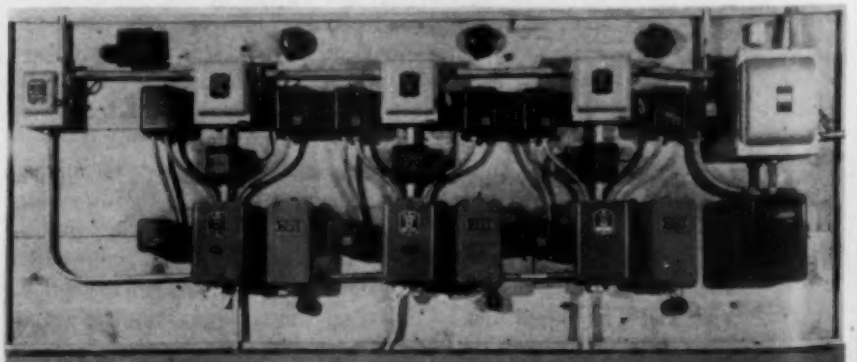
Further problems remaining after the choice of automatic firing were: (1) Automatic conveying of coal to the stoker hoppers; (2) flexibility of the conveying and distributing system to permit the use of one, two, or three boilers in any combination, with a minimum of supervision; and (3) access to the front of the boilers for cleaning tubes, and to the operating parts of the conveyor-stoker system.

Coal is delivered from a large storage room to a point above the stoker hoppers by a bulk conveyor and distributed from there to one or more stoker hoppers as needed by means of a screw conveyor.

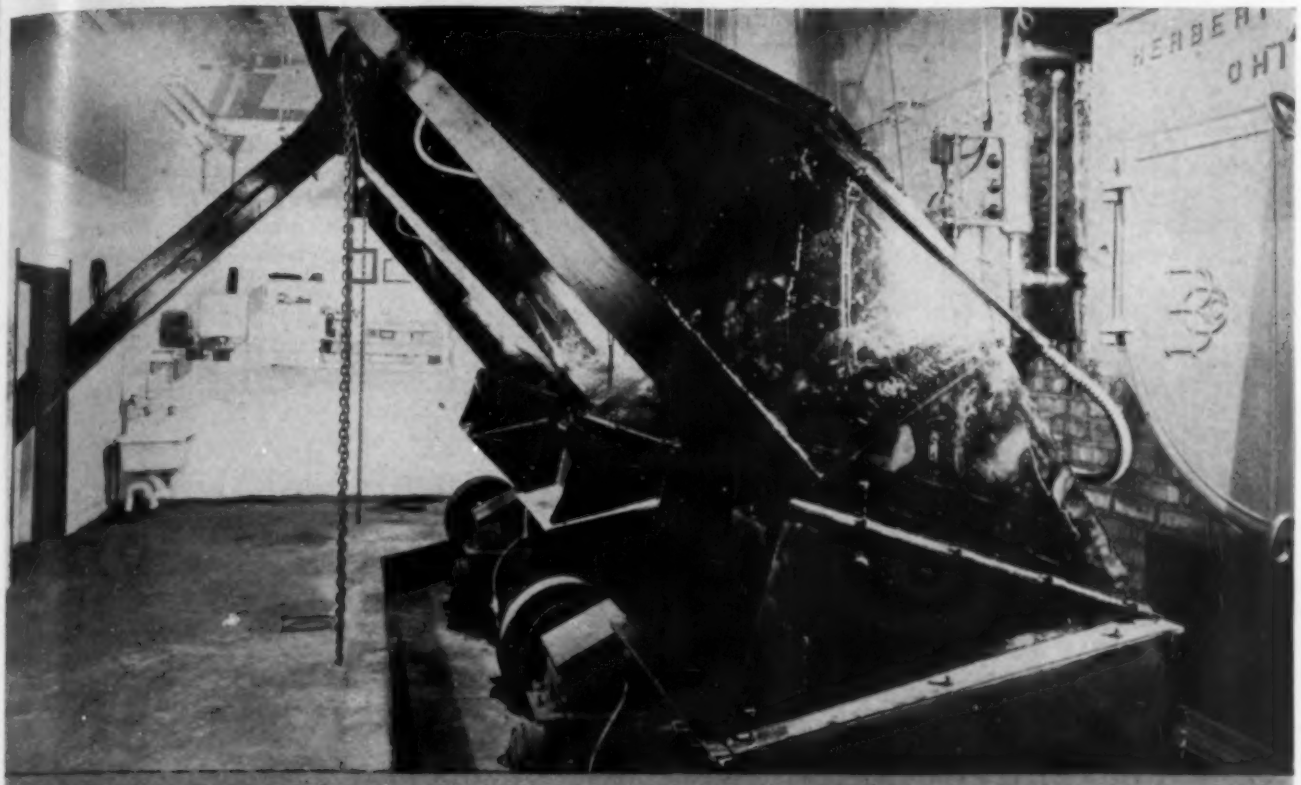
The bulk conveyor consists of an endless chain operating in a dustproof casing and fitted with a series of bent-plate flights that move the coal in compartments, yet permit it to discharge freely at the desired point. The horizontal part of the conveyor runs under the coal pile for a distance of 24 in., with a take-up section of 3 ft, 8½ in. in a small shed for accessibility. The inclined part of the bulk conveyor (at 45 deg) is 10 ft, 9 in. between the sheave section and the curved section that connects the horizontal and inclined parts. The conveyor loads on the top flights, which are above the lower, empty flights, and the coal discharges beyond the top sheave. The inclined part has inspection windows on one side. The bulk conveyor operates at approximately 30 fpm.

The coal is discharged from the bulk conveyor into the end of a screw conveyor that has openings over each of the spouts connected to the stoker hoppers. All connections are dust tight, to prevent coal dust in the boiler room. The screw conveyor has a 9 in. diameter screw operating at 75 rpm. Two of the conveyor openings are fitted with sliding gates controlled by a chain wheel in connection with a rack and pinion, so that the coal supply can be shut off independently as desired.

The hopper spouts are fastened to the hopper extensions by means



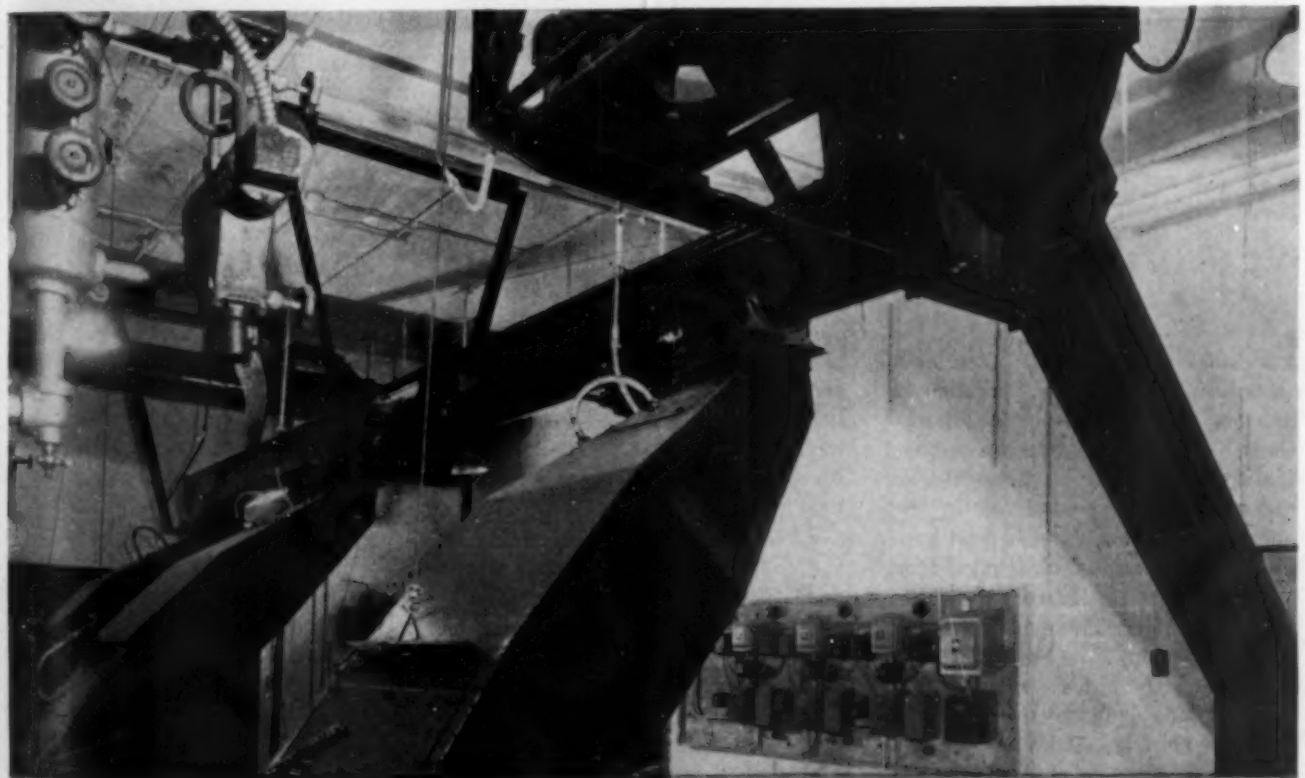
The control panel, with electric controls for the stokers, the bulk conveyor, and other components of the system



General view of the three stokers, delivery spouts, and elevator end of the bulk conveyor

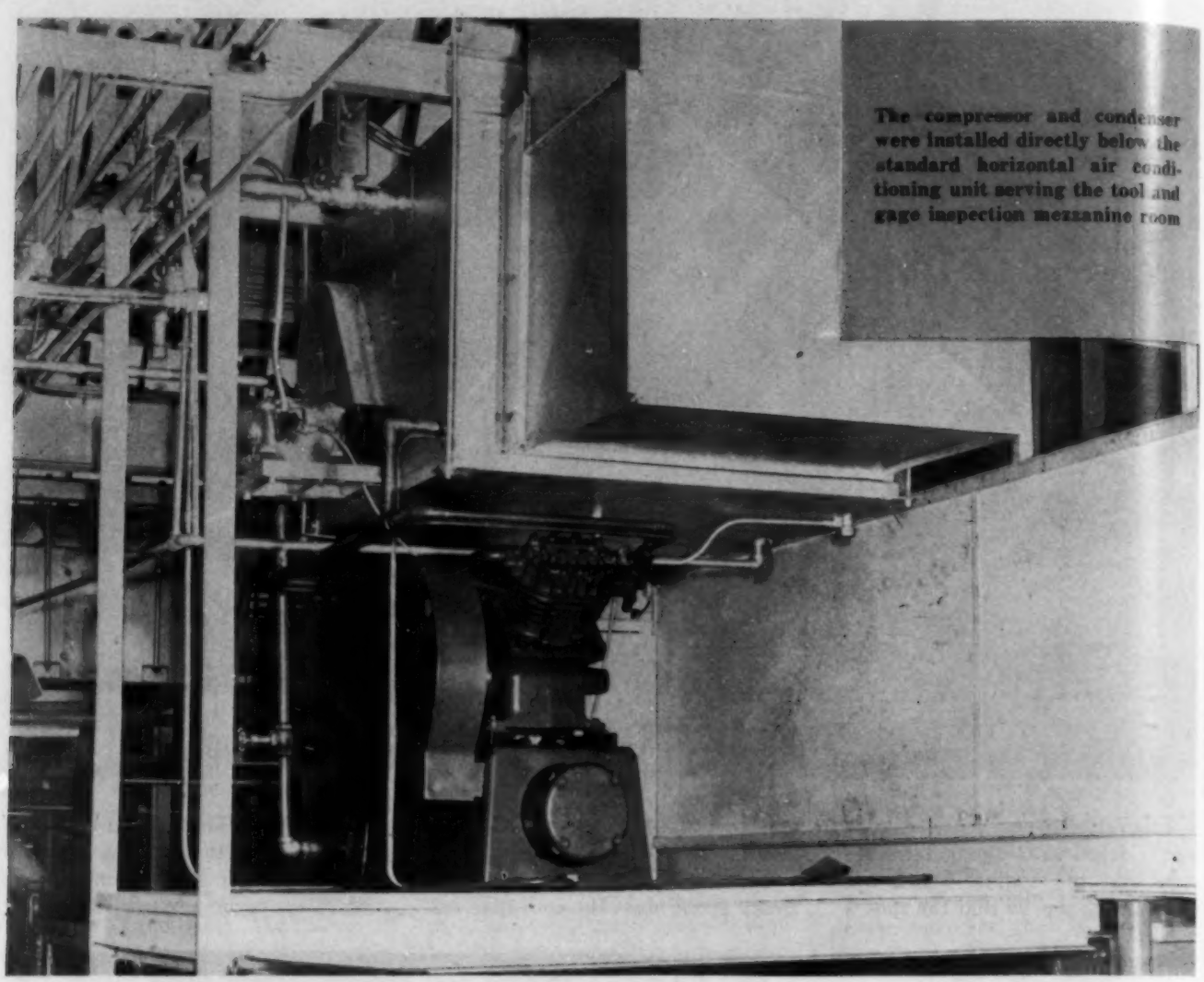
of removable clips. A wire rope hoist is attached to the boiler sides of each of the spouts, which are hinged at the top, so that the spouts can be raised to clear the boiler fronts when the doors are opened.

Two limit switches on each delivery spout start the conveyor system when the hopper coal supply is low, and stop it when the spout is full. A master switch controls the entire conveyor system.



(Photos courtesy Link-Belt Co.)

Limit switches on each delivery spout start conveyor system when the hopper coal supply is low and stop it when the spout is full



The compressor and condenser were installed directly below the standard horizontal air conditioning unit serving the tool and gage inspection mezzanine room

FLOOR SPACE WAS AT A PREMIUM

Air Conditioning a Mezzanine Tool & Gage Inspection Room

IN ORDER to provide an area with controlled atmospheric conditions for tool and gage inspection operations, when floor space for manufacturing was at a premium, a mezzanine was constructed in the open section above a tool and supply crib in part of two bays of a sawtooth type of factory building (see page 190). The slanting north lights and the roof provided the ceiling and the sides were enclosed with studded walls covered with asbestos-cement board, with windows all around. One-quarter of the area is used for storage and was left open to the factory atmosphere by the omission of glass in this section. The underside of the plank roof was furred and covered with insulating board and the skylights were painted with a special paint for eliminating glare and reducing heat transmission.

The controlled area is used for the inspection of tools and gages used in the manufacturing of precision parts. The need for atmospheric conditions which remain constant throughout the year for comparing manufacturing gages with standards and for checking tools and fixtures which are used to manufacture parts having close tolerances is well known. For accuracy, this work requires temperature control; however, a variance of 5 to 8 F is allowable. Because of the high finish on the standard gages and some of the parts manufactured, it is desirable to limit the relative humidity to eliminate etching from perspiration while parts are handled and to prevent ordinary rusting. The selected inside design conditions were, therefore, set at 72 F winter dry bulb temperature and 80 F summer dry bulb, with relative humidity not to exceed 50 per cent.

The temperature of the factory air around the mezzanine is equal to or much higher than the inside design conditions of the mezzanine.

This results in a very light heating load; in fact, when outdoor temperatures rise to 45 or 50 F, cooling—which can be obtained from additional outside air—is required. The heating load is handled by a single row steam coil which is also used for reheating.

Small Heating, High Cooling, Loads

The cooling load, however, is comparatively higher, approximately 50 per cent of this load being excess solar heat gain. Although the computed peak cooling load was 14 tons, a 10 hp, 10 ton compressor was selected because of its availability, and a four row direct expansion coil was installed. Methyl chloride was utilized as the refrigerant because of the "Freon" shortage.

The coils were installed in a standard horizontal air conditioning unit with a 4000 cfm fan and having a face area of 10 sq ft for coils and filters. This unit was connected to the duct system with control dampers for the regulation of recirculated air and outside air, as shown in the control diagram. The compressor and condenser were installed directly below this unit.

The control system is designed to take advantage of outside air for cooling; as was noted above, cooling is required during all seasons. Even on bright winter days the internal cooling load combines with the solar heat gain to make cooling necessary for short periods.

The temperature controller in the room, T_4 on the control diagram, has a modulating control for the steam valve. However, this thermostat senses a degree rise in temperature above its setting, at which point, provided the steam valve is closed, it sets the relay to allow the one modulating controller in T_1 to regulate the dampers to admit additional outside air to satisfy the cooling requirement. Controller T_1 is in the fan discharge to keep the air above a minimum setting, say 60 F, in order to avoid noticeable drafts from the discharge grilles which are necessarily only 7 ft above the floor. The second controller in T_1 also modulates the steam valve, if necessary, to maintain at least this minimum temperature. However, whenever T_1 or T_4 call for steam, the relay cuts the damper motor M_1 back to the control of the manual minimum position switch. Controller T_3 in the outside air duct is also set to open the relay to maintain the minimum outside air damper position when the outside air temperature rises to the temperature setting in the room, above which point it would increase the cooling load. The solid control lines on the control diagram indicate those which control the position of the relay.

A safety stat is installed ahead of the filters to close the dampers to outside air to prevent freezing in the steam coil should the mixture of recirculated air and outside air fall below 40 F. The controls are also interlocked so that if the fan stops, the dampers close to outside air, the steam valve closes, and the solenoid valve in the liquid refrigerant line to the cooling coil closes.

Starting and Stopping the Compressor

When the cooling load exceeds the possibilities of outside air cooling, or the humidity increases, the cooling thermostat T_6 or the dew point temperature controller T_5 in the room start the compressor indirectly by opening the solenoid valve in the liquid line of the direct expansion cooling coil. This valve starts and stops the compressor by low pressure cutout. The cooling thermostat T_6 is set to operate at a temperature about 5 F above T_4 to prevent these two controllers from overlapping ranges. If the moisture load is excessive, either T_1 or T_4 will admit steam to reheat air sufficiently to keep the dry bulb temperature in the room comfortable while maintaining the dew point temperature setting of T_5. The steam supply for this system is taken from the line furnishing steam for process work in the plant and therefore is available the year around.

Although the area is actually divided into two zones physically, the heating and cooling loads are actually proportional to the floor area so that only the quantity of air to each section had to be proportioned with relation to the area by setting the splitter damper where the ducts divide.

Because at times the conditions in the room can require 100 per cent outside air and the room is tightly constructed, an automatic shutter was set in the recirculated air duct outside the room to release the excess air into the factory. To prevent entry of dust, the skylights are sealed shut.

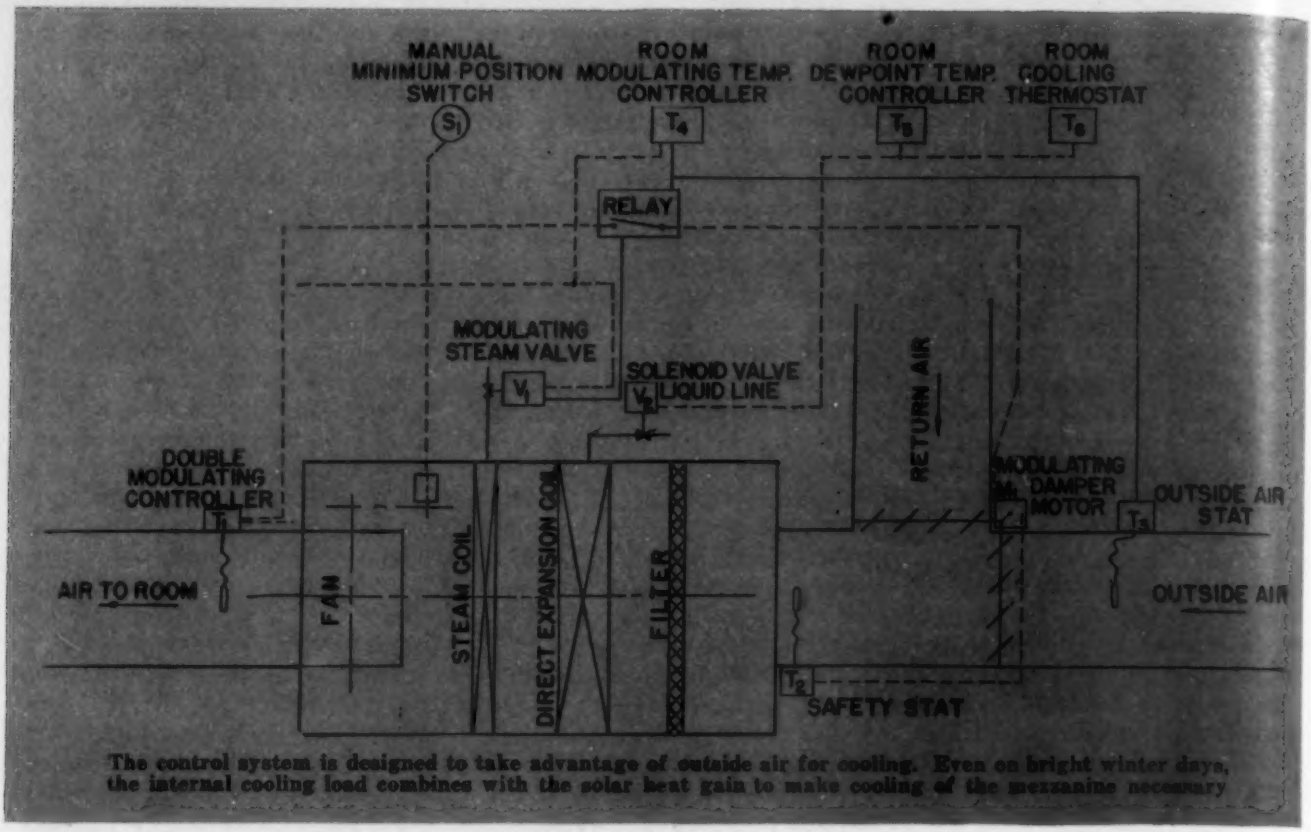
Water for condenser cooling is supplied from the factory pumping system. The low cost of this water, which is pumped from a river running adjacent to the plant, ruled out any consideration of an evaporative condenser.

At only two times during the last summer did the cooling load exceed the capacity of the compressor. However, at both of these periods the condenser cooling water

By Walter P. Wilkins, Mechanical Engineer

Saginaw Steering Gear Division
General Motors Corporation

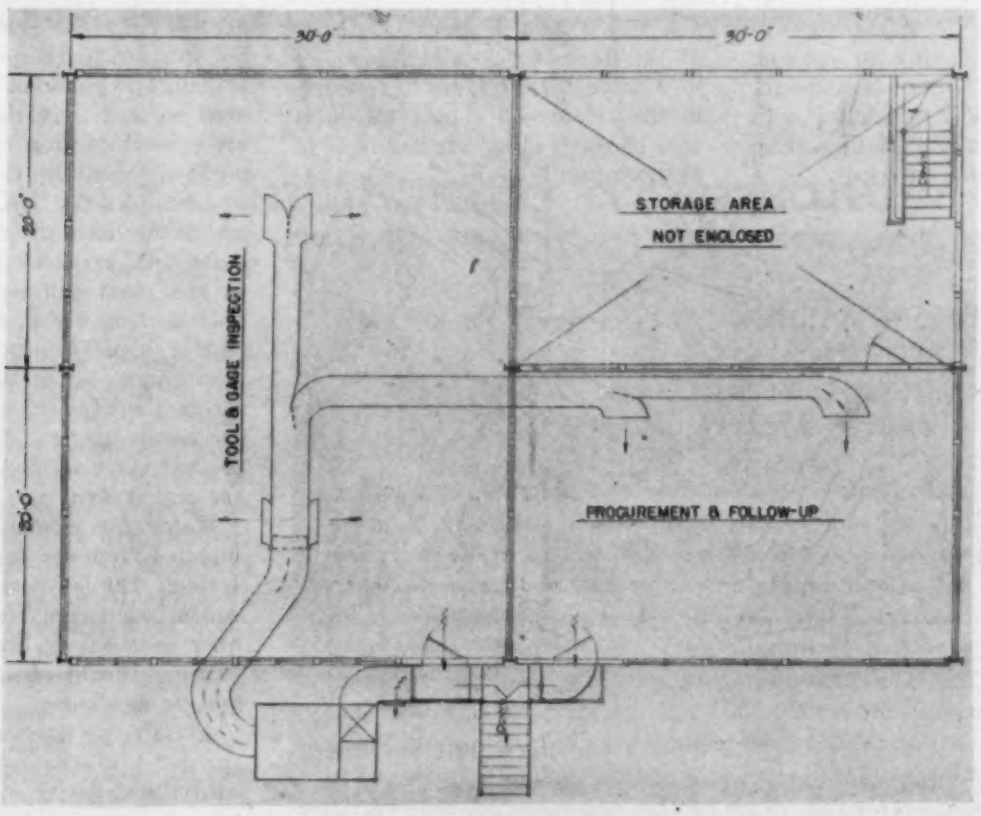
WITH FLOOR space for manufacturing at a premium, and with a need for controlled atmospheric conditions for tool and gage inspection operations, a mezzanine was constructed in the open section above a tool and supply crib in part of two bays of a sawtooth type factory building. Although the computed peak cooling load was 14 tons, a 10 hp compressor was selected because of its availability. The coils were installed in a standard horizontal air conditioning unit with a 4000 cfm fan, and the unit was connected to the duct system with control dampers for the regulation of recirculated and outside air. The control system is designed to take advantage of outside air for cooling whenever this is possible.



The control system is designed to take advantage of outside air for cooling. Even on bright winter days, the internal cooling load combines with the solar heat gain to make cooling of the mezzanine necessary

temperature was quite high and the compressor cut out because of high pressure. The temperature rise at these intervals in the rooms was not excessive.

With the exception of any changes to the dry bulb temperature which are desirable during the winter or summer, this system can operate the year 'round without any summer-winter switches to be operated and changes from cooling to heating, or vice versa, carry on automatically at the will of the thermostats.



Temperature of the factory air around the mezzanine is equal to or much higher than the inside design conditions of the mezzanine. This results in a light heating load, and a comparatively high cooling load

"Open for Discussion"

WHAT'S HOLDING BACK THE HEAT PUMP?

THE EDITOR—

The article by J. Mack Tucker, What's Holding Back the Heat Pump?, in the March HPAC, seems to me very timely in its emphasis on the fact that there is nothing mysterious about high coefficients of performance or "heat pickups." When taking a long range point of view on heat pumps, if there is any glamor in them, it seems to me to stem from the possibility of a substantially more efficient means of utilizing fuel for heating purposes than we are now using.

The conclusion that refrigeration equipment available today will not take full advantage of the heat pump idea seems to me to be an over-simplification that does not follow from the very excellent discussion illustrated by Figs. 1 and 2 of the article. In fact, air conditioning equipment is already available for this purpose today. As such it has been widely available for quite a few years and it has been specifically designed for the purpose. The article makes it plain that whether it is used for heating or cooling, its functions are the same and it seems logical to conclude that it ought to be reasonably well suited for the purpose. The principal innovations lie in the control equipment to make a single system conveniently available for both heating and cooling.

The use of air as the energy carrying medium has many attractive features, such as elimination of part of the heat transfer surfaces. It has been effectively used where the temperature range between condenser and evaporator is large, as in providing air at very low temperatures for supercharger testing. However, in the ranges required for comfort heating or cooling, the proportion of the power input to the compressor which must be recovered by the air engine is so high as to make the air systems inefficient and unattractive when compared with conventional vapor compression systems.—R. U. BERRY, manager, field engineering section, air conditioning and commercial refrigeration divisions, General Electric Co.

CENTRAL REFRIGERATION FOR AIR CONDITIONING

THE EDITOR—

There has been published considerable controversy on the relative merits of central refrigeration systems and local refrigeration systems for air conditioning, the latest being in the "Open for Discussion" columns of the February HPAC. On one point, at least, we are in agreement with O. W. Ott, who favors the decentralized systems, and that is that complicated and costly plants seldom can show savings of interest or depreciation on capital investment. We also might add that the complicated and costly plants increase the cost of maintenance, supervision, and operation. It is largely on the basis of simplicity that the present writers consider that the central refrigerating plant merits consideration under special conditions in congested areas. This applies especially to installation, operation, maintenance, and servicing.

In engineering, of course, when we compare methods of accomplishing our final objective we should be careful in seeing that our data are complete and accurate and that our conclusions are not over extended. Mr. Ott's criticism of the central station method consists largely of off-hand statements and a tabulation of power requirements in two blackout aircraft factories. The data are not representative of the merits of the two systems for conditions discussed in the article on page 65, front section, of the December HPAC, nor is the comparison as shown sound in an engineering sense, in our opinion.

First, let us consider an aircraft plant spread out over the countryside as an index to sound engineering practice in a congested area of a large city. The problems involved in any system are a means of supplying power, cooling the air, and

In between his strenuous duties as an American liaison officer in charge of a unit of the Chinese combat command, U. S. Army, attached to the Chinese expeditionary force, Col. Robert C. Lutz, former Harrisburg, Pa., heating engineer, finds time to investigate the intricacies of a clay charcoal burning room heater familiar to residents of southwestern China. As shown in the accompanying photo, heating units in the area in which Col. Lutz's group operated were of the simple type—usually open hearth fire pots of clay or bricks, burning wood or charcoal. The latter fuel is often in 10 or 12 in. lengths in contrast to the briquet-like charcoal available in the United States

disposing of the heat from the refrigeration cycle. In an aircraft plant in the open country, independent isolated units require only a distribution of electric power. The conditioned air can be treated locally and the heat of the refrigeration system can be disposed of through evaporative condensers or cooling towers locally. There is plenty of room and plenty of air for this disposal.

In a large city with a large air conditioning load in a relatively small area, the power has to be distributed and, in addition, either chilled water has to be distributed to local air conditioning units or condenser water has to be distributed to the local refrigeration units to dispose of the heat. It is hardly conceivable that hundreds of evaporative condensers with their floor space requirements, air requirements, and discharge of hot, humid air would be tolerated in even one large office building, much less in adjacent office buildings where it is difficult to find access for outside air for ventilation purposes and relief areas which will not contaminate other ventilation intakes even under today's limited usage of air conditioning.

In the matter of operation, maintenance, and servicing alone, one 7000 ton plant, for example, will be more satisfactory than 100 or more scattered, small plants with less competent supervision. It is also possible to operate the central station system with a few large units more efficiently and maintain a better load factor. Refrigeration engineers will recognize the power economy which the high load factor of a central system permits relative to the individual units. They will also recognize the greater flexibility and simplicity of the individual air conditioning units supplied with water over the direct expansion units which cycle frequently under some load conditions.

The two aircraft factory air conditioning systems for which figures were prepared by H. M. Hendrickson and used by Mr. Ott to represent the relative merits of the central and decentralized plants are made up on entirely different bases. The impression which Mr. Ott apparently intends to convey is that the auxiliary horsepower of the central plant is 45 per cent of the refrigeration machine horsepower and of the decentralized plant, 10 per cent, and that the operating costs for power are thus represented. In the central station system cited, the refrigeration machine is turbine driven and the tabulated auxiliary horsepower includes all the horsepower of the boiler plant installation. This has been added up as if it were comparable to the evaporative condenser power of the multiple all-electric system. This is not a correct or proper comparison.

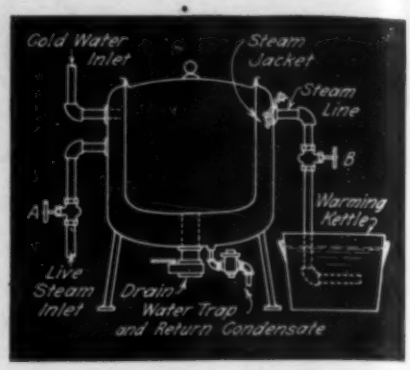
While the two systems are for aircraft factories, which situation is most unfavorable to the central station idea, they should either be converted to a common power basis or allowance made for the difference in cost of steam and electric power developed from that same steam source. You cannot charge steam power plant auxiliaries to the steam turbine driven unit and compare it to an electric driven unit except on a cost basis, because the electric unit must already carry the auxiliaries of the power plant where the electric energy was generated.

Pumping Chilled Water from Central System

In the matter of pumping chilled water from a central station system for distribution to the point of usage, there is undoubtedly a limit to the economical range of service. There will be, however, sufficient potential requirement within this range to justify this type of service, which would remove many of the handicaps now existing, to a wider application of air conditioning. The biggest problem, of course, is running the chilled water piping through city streets. Of course, it is possible that a secondary medium will some day be available which would have a higher heat carrying capacity than water, but there are many objections—including health, accident, and fire hazards—to piping some of the more common refrigerants through the streets as a cooling means, although this could be done very easily from a central centrifugal refrigerating plant. The installation of chilled water lines and pumping the chilled water is partly offset by the fact that, with the decentralized systems, condenser water piping and pumping would be required and the usable range of condenser water temperatures is no greater than of the chilled water while the condenser heat load is greater. It is not only difficult to find space and air for small evaporative condensers but it is also becoming increasingly difficult to find space for cooling towers. In tall buildings the roof space is hardly adequate for condenser water cooling for the conditioning equipment in the building below, and when adjacent buildings have cooling towers the problem is no longer simple. Low buildings are handicapped in this respect when adjacent buildings extend above them.

The auxiliary power of a central refrigeration system depends, of course, largely on the length of the chilled water distribution lines. However, within the range for which such systems would be applied the total auxiliary power, including chilled water pumping, condenser water pumping, and cooling towers, where used, will probably be 20 to 40 per cent of the refrig-

Here's an unusual case of contamination of the steam system at an industrial plant which was discovered by boiler water conditioning engineers. Food in this warming kettle was heated by turning live steam into it. Cafeteria employees, who naturally had little understanding of the steam system as a whole, on several occasions closed the steam inlet valve at "A" and left that at "B" open. The vacuum created by condensation of steam in the jacket around the kettle drew up food from the warming kettle, which found its way to the boilers, where it caused foaming. (Sketch courtesy of Hall Laboratories, Inc.)



eration compressor power. That of the decentralized plant may vary from 10 to 30 per cent, depending on building conditions. The cost of power for the larger central plant would obviously be less because of a more favorable rate and because of a better load factor and a higher average operating efficiency. Peak power demand is one thing; the integrated hourly consumption is quite different. These economies are in addition to those of operation, supervision, maintenance, servicing, and the savings of valuable floor space.

While the absorption refrigeration system is still used in industrial plants and is finding some application in small systems, it is doubtful that it will be accepted for general usage in large cities unless some radical change is effected in its performance. Its heat disposal problem is entirely too great to be considered sound engineering in scattered decentralized systems in large cities.

The Centrifugal Central Refrigerating System

Of course, the thing which makes the large centrifugal central refrigerating system feasible today is its present state of high development. Few engineers seem to have kept themselves abreast of these developments. It is entirely improper to compare the modern centrifugal system with the antiquated steam engine plants or steam absorption plants except to emphasize the great advances that have been made. The flexibility and operating economy of the centrifugal refrigerating machine when driven by either a high or low pressure steam turbine running condensing, or by an electric motor, result in a most economical means of producing cooling for the variable demand of air conditioning.

It is always bad research to draw general conclusions from isolated special cases, and sound engineering dictates that, when we are comparing systems, we recognize the wide range of conditions to be met and be sure that our data are in comparable terms.—A. C. BUENSOD and R. W. WATERFILL, Buensod-Stacey, Inc.

WHEN ENGINEERS gather to hear a paper or talk, there comes a time when the meeting is thrown "open for discussion." We follow this custom in these columns, which provide an opportunity for readers to comment and discuss articles published in HPAC and other topics of interest to heating, piping, and air conditioning engineers and contractors. Others are interested in your views on these matters, and the editors will welcome your remarks. Address them to Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

CHANGING OR CONSTANT TEMPERATURE?

THE EDITOR—

Is a changing temperature during the day in an air conditioned space more conducive to comfort of the occupants than a temperature held at some constant value? That's a question asked by a reader of HPAC, and it was commented on by Charles S. Leopold, consulting engineer and member of HPAC's board of consulting and contributing editors, and Cyril Tasker, director of research of the American Society of Heating and Ventilating Engineers, in the October 1944 issue, pages 568-569. It was well discussed by Messrs. Leopold and Tasker, but I thought much more comment would follow. Mr. Leopold said ". . . The proper indoor atmosphere is one of which you are not conscious . . .," but Mr. Tasker reported work of Dr. Bedford of England and Dr. Velander of Sweden indicating preferences for varying temperatures. The apparent conflict between these opinions brings out an interesting point. This is the difference between optimum conditions for rest and for work. Mr. Tasker uses such words as "invigorating" and "stimulating" to describe the effects of varying conditions. Although such a description would seem to suit a man at either physical or mental work, it is more likely to be disagreeable to a man at rest in his home, or relaxed for enjoyment in a theater.

This invigorating atmosphere reminds me of an experience 25 years ago. The manager of a building was complaining about the alternating shots of hot and cold air in his rooms which were heated by individual ducts equipped with mixing dampers, controlled by room thermostats. The installation was distinctly substandard from the control standpoint, but the heating engineer, in a moment of generosity toward the control contractor, convinced the manager that he was objecting to a condition that was specially designed for its stimulating effects. So far as I know, the condition still exists.

For normal occupancy in this country, the preference for uniform conditions is confirmed by experience with thermostats, where most complaints come when the control is not close enough.

With the discussion in the October HPAC, the ASHVE comfort chart was published. Although this chart has been accepted in essentially its present form for 20 years, most thermostatic control devices are still installed for following the lines of constant dry bulb instead of lines of constant effective temperature. Now we recognize another factor modifying the effect of dry bulb temperatures. With the growing interest in panel heating, the heating industry is becoming more conscious of the importance of radiant effect on comfort. Whether or not a panel system is used, the chilling effect of body eradiation to cold walls and windows is receiving more attention. If warmed surfaces are not interposed so as to offset the chilling effect, air temperatures must be raised to produce an average state of comfort in the room. The amount of this increase depends on the area (and temperature) of the surface that produces the chilling. It is suggested that 1 or 2 deg would be sufficient for most cases.

It happens that this need for correction is additive to the relative humidity correction indicated by the comfort chart, because it can be assumed that lower indoor relative humidities follow lower weather temperatures, where humidification is not supplied. The total correction is obviously at least 4 deg, as 3 deg is indicated for relative humidities between 60 and 30 per cent.

In general comfort control work, a tolerance of plus or minus 1 deg is allowed. This adds further to the

wandering of the control into the range of discomfort. For example, if the correct "line" of comfort requires 4 deg higher dry bulb temperature in zero weather, than at 60 F, perfect (unvarying) dry bulb control adjusted in moderate weather will be 4 deg too low in zero weather, but the 1 deg tolerance carries the control point another degree from the correct place.

With modulating control there is still another factor related to, and taking the place of, the tolerance just mentioned. A modulating thermostat is designed with a set (or adjustable) differential between the points of all-heat-off and full-heat-on. Within this differential as the temperature falls, more heat is turned on. Conversely, the temperature must fall to turn on more heat. Thus, in cold weather when most heat is needed the control point is lower than in warm weather when little heat is supplied. The greater the differential, the more "gradual" the action of the thermostat, but the greater this factor becomes.

The characteristic just described does not add to the discomfort mentioned in the paragraph on tolerance, but it indicates the need of correction for the tolerance, because with modulating control the variation from the control "line" is upward in warm weather and downward in cold.

During the cooling cycle, these factors tend to disappear. Although the higher effective temperature lines form a greater angle with the dry bulb lines, the relative humidity variations in most installations are relatively small. Furthermore, as Mr. Leopold indicated, it is probable that the winter comfort zone should more nearly coincide with the summer zone. The characteristic differential of the modulating thermostat gives a higher temperature in hotter weather which is in the right direction if a constant point is not to be maintained. The radiation factor becomes negligible.

During the heating cycle, however, the several factors seem to prove the need for thermostats that control at higher temperatures in colder weather. From the manufacturer's standpoint, this should be about 4 deg, plus (for modulating thermostats) the differential of the instrument. This may seem an unnecessarily large correction, but I think almost anyone who receives complaints about the operation of thermostats in winter, will agree that most of them in cold weather are about underheating. Perhaps the customer is right and the design is wrong.

The discussion in the October issue pertained to "changing temperature during the day." Although my points seem to apply more to seasonal changes, they would cover daily variations at those times when there is a daily swing of 20 or more degrees. If I have gone too far astray from the subject, may I ask you to consider this a new one, with a prospect for further discussion?—F. C. McINTOSH, Johnson Service Co.

AIR CONDITIONING RESULTS DEPEND ON GOOD DESIGN

THE EDITOR—

During the past six or seven years the possibilities of air conditioning have been fully exploited by magazine and radio advertising. The public has been made very much aware of the advantages of air conditioned stores, offices, homes, hotels, and industrial plants. Not only have they been informed as to the advantages, but also they have been led to expect miracles therefrom.

Many eager aspirants have been persuaded by the advertising to get into this bigger, better business. They have spent time and money taking shortcut courses in dry bulbs, wet bulbs, dew points, enthalpy, etc., so that they may reap a full measure of the prosperity at hand in the coming expansion of air conditioning.

Unfortunately, many people have been, as it were, let down with a dull thud by the operating results of some of the various air conditioning installations with which they have had personal contact. Also, some people who work in air conditioned buildings are very caustic in their criticisms about drafts and both heating and cooling results.

Most of the complaints occur in the in-between seasons of spring and fall, and more complaints are

Do All You Can to SAVE FUEL!

registered about heating than cooling. Some folks even say they would rather go back to the older office buildings with the steam radiators under the windows. With some people it is hard to discount the advantages of a radiator you can turn on and off and a window you can open and close as you please.

Recently the president of a local industrial concern who wanted an all year air conditioning system for a new office building brought back a lot of adverse comments from some of the office buildings he had visited on an eastern trip. He wanted an installation in his new building completely zoned and with proper temperatures and effective air circulation in each and every room. He did not want to sacrifice any office room space for individual vertical return ducts to insure good air circulation, nor was he willing to O.K. the cost of individual ducts and controls for all rooms.

Today the problem of delivering the finished product—warm air for heating and cold air for cooling—is just as much of a problem as it was 30 years ago. Perhaps today the average duct system gets better engineering in its design than that which obtained 30 years ago, but I personally believe that the answer is often "No."

Then there were many violent discussions comparing so-called blast and split systems of heating and ventilating. Often an old-time blast job where the exact quantity of heat was supposed to be delivered at all times to each room by the duct system has been remodelled to put direct steam radiators in each room and to supply ventilating air, only, through the duct system. The possibilities of opening and closing windows and turning on and off radiators appeals to most school teachers who have previously contacted blast heating and ventilating systems.

Today it seems to me that in many respects we as engineers have failed to profit by the fundamental lessons learned 20 to 30 years ago in air circulation and distribution for heating and ventilating and even in steam distribution. It is so easy to put "trained arrows" on a blueprint depicting complete and exact circulation of the supply and return air, but unfortunately the trained arrows often slip very badly, for the air circulation actually ends up on a "nature takes her course" basis.

Sales engineering proclaiming miracles for this grille or that outlet would almost make you believe that excessive delivery velocities are quite all right. Air circulation in any given room always will be a matter of careful analysis for that room. To hastily decide that any combination of supply or return will do the trick is sometimes not so good. The trained arrows in equipment catalogs show the supply air sweeping down to the floor and filling all corners. Actually such results are not easy to obtain when the installation is completed and it has to be operated over the full range of air temperature from hot in the heating season to cold in the cooling season. Today some of the more elaborate catalogs might almost convince you that excessively high velocity can be compensated for by special grille or outlet design.

Results Are Judged by Air Circulation and Distribution

The final operating results of an air conditioning installation are judged more by air circulation and distribution than by any other features, and this is particularly true in the in-between seasons. This means that proper locations of supply and return grilles and the correct quantities of air for each room or subdivision thereof must be given full consideration when the original plans are formulated.

Sometimes the designing engineer will not insist on the architect or owner allowing sufficient building space for equipment and duct systems. In the equipment room fans, coils, plenums, filters and mixing chambers with their dampers are so badly crowded that air quantities are penalized, and excessive static pressures are developed. Filters and coils channel and generally poor control results. Through the building the space allocated for ducts is limited by structural conditions and so ducts are crowded in by making them excessively wide for their depth as well as reduced in size far beyond what they should be.

Where franchised dealers are competing direct for a given job, conditions are still worse in this respect. The dealer who crosses up with an owner or architect in insisting upon sufficient room does not generally get the contract. The one with all the shortcuts in design and the least tonnage does, for he comes in with the lowest price.

There is a tendency in equipment design that recently came to my attention in making a survey of a number of small year 'round air conditioning installations. This was to cure operating difficulties by adding more and more automatic controls and devices. My suggestion is that we should try to get along with less, rather than more, automatic devices. Simplicity in design with the minimum of automatic controls should be the end point for all small air conditioning systems for homes and the small commercial installations such as drive-in restaurants, cocktail bars, etc.

In this survey some other interesting conditions were observed. One building had a 35 foot-candle indirect incandescent lighting system. The heating effect of the ceiling which had to be offset by the cooled air brought into the rooms by ceiling outlets was actually equivalent to a panel heating system sufficient to take care of 50 per cent of the winter heating load. To cut down sun effect, inside venetian blinds had been installed.

Theoretically, I suppose the designing engineer will not be expected to provide cooling capacity for sun effect through windows and room lighting simultaneously. In this building, however, I found on days with plenty of good hot sunlight, that all lights were on to offset the tightly closed venetian blinds. A blackout building would be better than this combination.

On a 5 ton drive-in restaurant job, 1 ton of refrigeration was used up offsetting duct loss to a torrid zone roof space. A 1 in. layer of rock wool sandwiched between brown wrapping paper and loosely wired to the duct was the insulation provided for a 140 F exposure. A thin layer of loose insulating material had been placed between the ceiling joists, but there was no insulation on the underside of a 1 in. board roof. Pressure on the architect when the building was in the plan stage would undoubtedly have secured a well insulated roof.

In another instance, the calculations had been set up for 75 per cent return air, but a poorly designed return duct system produced only 25 per cent return air. The penalty of 75 per cent outside air cut down the delivered cooling effect very materially.

Short Circuiting Between Supply and Return

On another job there was not room enough in the furred ceiling spaces for both supply and return ducts and so the remaining space around the supply ducts was used as an exhaust plenum with combination supply and return outlets with the center sleeves piercing the supply ducts and opening into the plenum space. The net result was a heavy penalty on effective cooling from the additional outside air required to make up for the deficient return air. The disparity between supply and return air velocities through the ceiling outlet channels also resulted in some short circuiting between supply and return air.

Thirty years ago the ventilating installations in theaters proved the impossibility of getting uniform distribution through mushroom ventilators fed from entire floor plenum spaces. It is difficult enough to get effective distribution with duct systems connecting directly to individual supply and return outlets or grilles.—O. W. Ott, consulting mechanical engineer.

One of the most important war jobs that a civilian can do is to conserve fuel—coal, oil, or gas. The elimination of fuel waste is a patriotic, wartime duty . . . In addition, it is good business and good engineering. Cooperate with the National Fuel Efficiency Program of the U.S. Bureau of Mines.

Sam Lewis' Page

HOW TO GUARD AGAINST CONTAMINATION WHEN HEATING PROCESS TANKS BY STEAM INJECTION

SOME YEARS ago a very interesting research carried on in cooperation with the National Association of Master Plumbers demonstrated that water supply piping easily can be corrupted by foreign material drawn back into the pipes from basins or water closets if there is not provided a definite air break between the water supply outlet and the surface of the liquid in the receptacle. Thus, to prevent contamination, all bath tub and lavatory and sink supply faucets must be well above the rim of the receptacle and all flush valves on water closets must have vacuum breakers that infallibly will prevent back siphoning of liquid if subatmospheric pressure ever occurs in the water supply system.

There are a great many tanks and receptacles employed in industry, in which corrosive or abrasive liquids and sludges are maintained, and which are heated by injecting live steam below the surface, usually through nozzles arranged to mix the steam and condensate with the circulating liquid in such manner as to minimize noise.

The ease with which a tank of liquid can be heated by such injection and the low cost of the physical appliances required militate strongly in its favor. Against such a scheme is the obvious necessity of replacing the condensate thus lost with new feedwater in the boiler. In many localities the feedwater is heavily laden with suspended materials that remain to form scale in the boiler so that pretreatment is required. In some cases various chemical nostrums intended to prevent formation of scale and to permit the removal of the unevaporated salts by frequent blowing down are employed. One finds it difficult to sympathize with a boiler compound that is alleged mysteriously to do away with scale without some definite schedule of blowdowns and without frequent chemical analysis of the boiler water.

In a very large plant engaged in precision machine work and using many degreasing and chemical treating tanks heated by steam injection, there has appeared unusual difficulty in maintenance of boiler tubes, and various return pipes, many of recent installation, have developed leaks due to some internal influence. A striking phenomenon in many of the leaks in these small steel pipes is that they occur through threaded ends adjacent to screwed fittings, always in the bottoms of the pipes. The cast iron fittings adjacent to these leaks are channeled with deep, sharply defined grooves, as though cut by a sand blast at high velocity. Evidently the condensate flowing through the pipe carried a sharp abrasive material that became especially effective as a cutting agent wherever an eddy, as at the end of a nipple, and wherever a change in direction, as at an elbow, occurred.

Sediment Pockets Loaded With Debris

The sediment pockets at ends of steam mains were opened and inspected. All of them were well loaded with debris, including abrasive material like fine, sharp sand as well as metal cuttings and pieces of ferrous scale.

In one sediment pocket at the base of a 6 in., 125 psi process steam riser there were more than 90 cu in. of this sort of material. In all sediment pockets located prior to the vacuum traps of the low pressure heating system, commensurate volumes of this same abrasive material had accumulated.

The operating engineer at first stated that steam pressure never was allowed to fall below atmospheric pressure in the 125 psi process mains, since the plant runs 24 hr a day every day, but eventually he admitted that, of course, there were rare times when necessary repairs and additions required shutting down the system. At such times subatmospheric pressure could exist throughout parts of the piping and if an operator at a sludge-loaded or acid-containing process tank opened a steam valve, the objectionable material would be forced by atmospheric pressure, probably in considerable volume, into the steam piping; and thus would be on the job to wreak no good for the equipment that it could reach.

How to Avoid Difficulty

The deduction from this tale is to bespeak consideration of some less hazardous means of heating potentially destructive liquids than that of injecting steam directly into them.

Experienced designers of oil preheaters using steam, as applied to bunker C oil burners, generally recommend discharging the condensate to the sewer rather than returning it to the boiler, for fear of leakage of oil into the boiler or of water leaking into the fuel oil.

It is suggested that an elementary precaution in the case above cited might be the installation of a highly dependable automatic vacuum breaker between every steam control valve to an injection-heated process tank and the tank.

Another precaution might be to install a transfer heater for each such tank, circulating the liquid therefrom around a steam heated manifold, wasting the condensate rather than returning it to the boiler, and in addition installing the same vacuum breaker to prevent possible back siphonage.

* * * * *

IN THIS regular feature, informal comment on heating, piping, and air conditioning problems is given by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors. This month he suggests precautions which should be taken to prevent damage to steam piping when industrial process tanks are heated by the direct injection of steam.

...on Operation, Maintenance, Repair, Alteration, Extension

Organizing Operation and Maintenance of Industrial Air Conditioning Systems

By R. D. Tutt

Supervisor of Air Conditioning
Allison Div., General Motors Corp.

ALONG WITH the great strides that air conditioning has been making in wartime applications, the operation, maintenance, and service problems have also increased. Too often in the past, operation of most air conditioning systems meant merely pressing the start button of a compressor or fan at the beginning of a season and allowing the equipment to run automatically until it failed, or did not perform its particular function. Service was usually had by calling the contractor, distributor, or manufacturer of the equipment, or possibly a regular refrigeration service organization. Maintenance was usually limited to the actual replacement of defective parts of the systems. These various services were performed well enough until the industrial plants began to install compressors five to 10 times as large as was the average in the past in conjunction with air conditioning systems handling air volumes that were unthought of a few years ago.

The constancy of the control demanded of these systems, and the intricacy of the control systems installed to provide that constancy, became such that several days or weeks were required to familiarize oneself with the entire system in order to intelligently "shoot" trouble on them. The type of equipment in general was different from previous smaller air conditioning installations with which most service outlets and owners were familiar. Equipment manufacturers, on the other hand, could not be expected to provide operation, maintenance, and service, because of the 24 hr a day operation required of most installations, and the widely scattered locations of such installations.

Thus it was that the industrial plants using air conditioning on a major scale began to set up their own air conditioning service organizations. In many cases where the installation was not large, the work was done by the maintenance departments, the plant electricians doing such control work as was necessary and the steamfitters or plumbers handling the refrigeration, with possibly an outside refrigeration service source being brought in for major work.

In a large industrial organization, the furnishing of heat, light, power, water, compressed air, air conditioning, and similar utilities may come under the power section of the plant engineer's department. Air conditioning in this case actually becomes a utility and is regarded as such from the viewpoints of operating cost, equipment, and amortization. Let us consider, then, the organizational arrangement of a typical air conditioned aircraft plant and how this organization functions to operate, maintain, and service the air conditioning equipment. For the purpose of giving scope to the example, let us assume that the total installed tonnage of this plant is composed of five 1000-ton centrifugal compressors, operating on a water cooling system delivering water to 50 air conditioning systems situated at various parts of the building as zones.

Air Conditioning Engineer in Overall Charge

This company secured the services of an air conditioning engineer who had been connected with the consulting engineering field as well as the service departments of equipment manufacturers. All problems of operation, maintenance, service, and additional design or revamp of present systems

or parts thereof pass his desk. He is also advised of any major machinery moves or changes in the load within the building while such changes are still in the planning stage, so that he may make any necessary corrections in his operations or in his system design. This man answers directly to the chief of the power section, plant engineer's department. The air conditioning engineer directs the activities of his organization through a general foreman who is responsible for all actual operation, maintenance, and service on a 24 hr day basis.

Since this particular plant is on a 24 hr per day basis, it was necessary to set up shifts to control the entire operating cycle. This condition made it necessary to appoint foremen for each of the shifts, answering to the general foremen. These foremen were recruited from men with temperature control and small refrigeration service experience. This particular organization feels that after a four year operating experience, men with such a background provide the best material for operation and maintenance due to the fact that the principles of refrigeration and temperature control are the same whether the installation be large or small. The supervisory staff then shows an organization chart as given in Chart No. 1.

Rotating Shifts for Air Conditioning Attendants

In this particular plant, rotating shifts were used for the air conditioning attendants (a separate classification set up by the management for men working on an hourly rate on air conditioning duties). A four week shift was determined to be the most efficient to enable the worker to become acclimated to the shift. Rotating shifts likewise give the advantage of having experienced men on all shifts instead of all old employees from the standpoint of seniority on the day shift and all new employees on the night shift. Hence, one day a week, each employee has one day off.

In addition, the air conditioning department in this plant was given the responsibility of maintaining and operating all fan and air handling devices in the plant, such as dust collectors, exhaust fans, spray booth fans, plating room air washers, etc. This naturally resulted in much cleaning work of a janitorial nature, in addition to that work to be done by skilled mechanics. For this work, on both air conditioning and manufacturing facilities using fans, janitors were hired. These men do not rotate, since the skill required is not sufficiently great to warrant it. However, the supervisory arrangement remains the same. The final organization chart now appears as in Chart No. 2.

DESIGN AND installation of an air conditioning system for a plant or large building is but half the story; operation, maintenance, repair, alteration, and extension of the equipment must be given careful attention to assure satisfactory results. Mr. Tutt explains here the organization for operation and maintenance at a large air conditioned industrial plant. Chart No. 1 shows the basic set-up. Chart No. 2 adds the air conditioning attendants and janitors for the three shifts, and Chart No. 3 shows how the scheme was expanded when a second plant similar to the parent plant was built.

Unlike standard power house operation in many plants, the five air conditioning attendants on each shift as shown on Chart No. 2 rotate at their jobs, i.e., one week two men each shift operate the systems, making temperature control adjustments, taking machinery logs, etc. The next week, two other men will do this work and the previous two will be concerned with mechanical work on fans, bearings, filters, etc. While this method of shifting working assignments is somewhat costly, it is in reality a broad training program which stood this firm in good stead when losing manpower to the armed forces or for other reasons. With all members of the organization familiar with the main phases of the jobs, absenteeism or manpower losses do not seriously cripple the performance of the organization.

It further proved desirable when the work of this plant required the addition of another plant of twice the installed tonnage of the first. The organization was split, with part of the trained personnel going to the new building, which was constructed several miles from the parent plant, and part remaining at the parent plant. Inasmuch as design of the air conditioning for the new plant came under the air conditioning engineer, and inasmuch as the manufacturing processes to be conducted in the new plant were similar to those of the parent plant, designs of systems, temperature control cycles, and equipment were held standard with those systems which the air conditioning men were accustomed to operating—with the result that the new plant started up with much more efficiency and smoothness than would have been the case had entirely new designs of systems and equipment been used. Lubrication schedules and methods of operation and maintenance previously established in the parent plant were easily transferred to the new plant. Further, maintenance and repair parts stock were naturally reduced due to standardization of design. The final organization chart now appears as shown in Chart No. 3.

New men were then brought in to fill up the ranks of those trained employees in both the parent plant and the new plant for subsequent training to secure the final personnel requirements at both plants. By the very nature of this work, the ratio of supervision to employees is low, being, in the worst case, approximately 15 to 1. However, this is more than offset by the widely diversified activities these men must perform, the area they must cover, and the training program necessary in wartime.

Friendly Rivalry Between Plants

Friendly rivalry is promoted between the plants on safety, operating costs and efficiency, training, etc. Similarity of records kept are such as to convey at a glance the number of complaints, operating costs per unit of measure, etc., between the two plants, and an organization is thus apparent that conducts its work along standard lines with a minimum of lost motion.

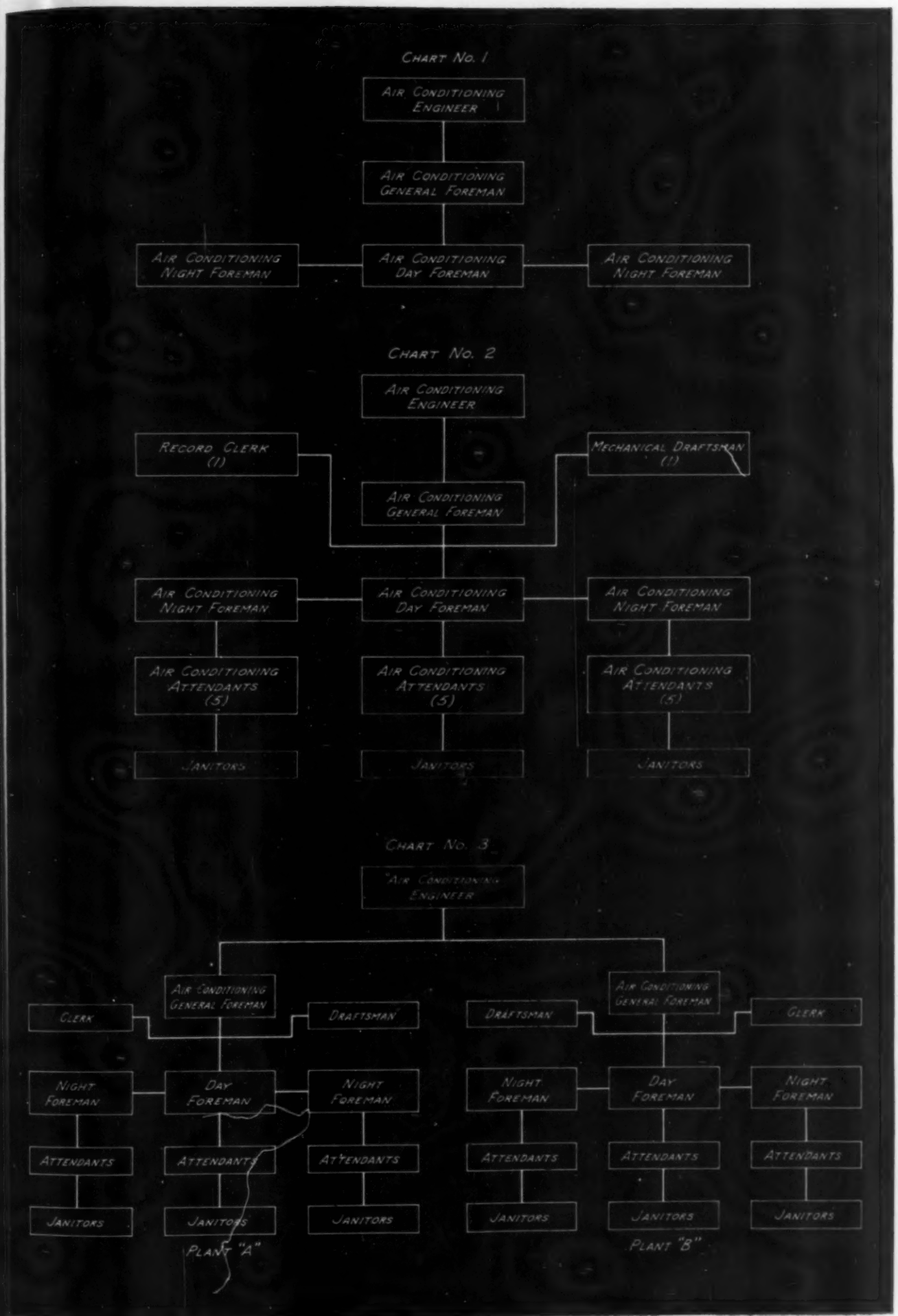


CHART No. 1
AIR CONDITIONING ENGINEER
AIR CONDITIONING GENERAL FOREMAN
AIR CONDITIONING NIGHT FOREMAN
AIR CONDITIONING DAY FOREMAN
AIR CONDITIONING NIGHT FOREMAN
CHART No. 2
AIR CONDITIONING ENGINEER
RECORD CLERK (1)
MECHANICAL DRAFTSMAN (1)
AIR CONDITIONING GENERAL FOREMAN
AIR CONDITIONING NIGHT FOREMAN
AIR CONDITIONING DAY FOREMAN
AIR CONDITIONING NIGHT FOREMAN
AIR CONDITIONING ATTENDANTS (5)
AIR CONDITIONING ATTENDANTS (5)
AIR CONDITIONING ATTENDANTS (5)
JANITORS
JANITORS
JANITORS
CHART No. 3
AIR CONDITIONING ENGINEER
AIR CONDITIONING GENERAL FOREMAN
AIR CONDITIONING GENERAL FOREMAN
CLERK
DRAFTSMAN
DRAFTSMAN
CLERK
NIGHT FOREMAN
DAY FOREMAN
NIGHT FOREMAN
NIGHT FOREMAN
DAY FOREMAN
NIGHT FOREMAN
ATTENDANTS
ATTENDANTS
ATTENDANTS
ATTENDANTS
ATTENDANTS
ATTENDANTS
JANITORS
JANITORS
JANITORS
JANITORS
JANITORS
JANITORS
PLANT "A"
PLANT "B"

Regular Testing of Steam Traps Aids Wartime Heating Efficiency

By L. W. Mauger

Supervising Engineer
Brown, Wheelock, Harris, Stevens, Inc.

THE PROPER use and maintenance of steam traps may mean the difference between efficiency and inefficiency in a vapor or vacuum heating system. Except in orifice systems the trap is the only means by which air and water may be eliminated while steam is retained until it releases its latent heat to the radiating surface. A trap is defective if it cannot properly distinguish between steam and the air and water—that is, if it passes steam, or holds back air or water.

A thermostatic trap depends for its action upon the expansion and contraction of a metal or liquid. A crack or hole in the metal will alter the operation or release the liquid. Dirt under the needle, corrosion or wire drawing of the seat or needle, or failure of the needle to center on the seat may allow steam to pass. Improper action may result if a trap is calibrated for too high or too low a temperature, or if it is installed with too great or too little distance between the top of the element and the seat.

Experience has shown the value of regular, systematic inspection of traps to ascertain their effectiveness and responsiveness. Checking the trap should be routine whenever there is a complaint of an inoperative radiator, but often a trap in another radiator connected to the same return line may be passing steam, the heat from which may expand an element in another radiator trap—making the trap appear defective. A superficial check of radiator traps can be made by listening to their operation. Some observers have become so expert that they can determine by sound if a trap is holding water or passing steam. A metal rod held on the trap body, or a stethescope, will assist in this determination.

A more popular method of checking elements is by means of a testing rack in which a standard trap body is connected through valves to a source of steam and water. The element to be tested is placed in the body and hot water is turned on to be certain that the trap is open and clear. Steam is then supplied gradually and the discharge from the trap is observed. Some steam will pass while the element is heating, but then the trap should close tight and hold until condensate begins to accumulate. Some vapor may then appear due to re-evaporation, but this can readily be distinguished from live steam because it would be accompanied by water and would not come out under pressure. Steam may now be left on and hot water turned on and the element should then reopen. If the element does not respond properly during this test, it should be discarded.

IT IS A patriotic duty in wartime, and good business and good engineering at any time, to take all the steps possible to conserve fuel. One important way of promoting heating efficiency is to be sure that all steam traps are functioning properly. This demands regular inspection of trap elements, and repair or replacement of any units found defective.

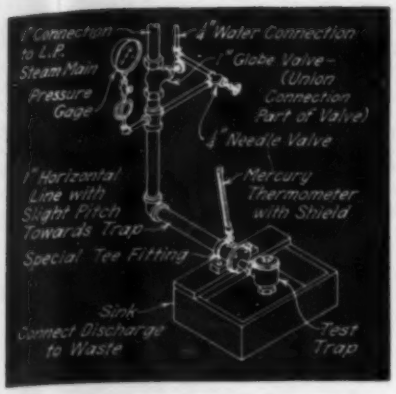
If greater accuracy is desired, a thermometer and pressure gage may be added and the temperatures and pressures controlled to conform to the actual conditions under which the trap is expected to operate. One engineer made a further refinement by drilling a hole of about ¾ in. diameter on two opposite sides of a trap body and having a jeweller set pieces of Pyrex glass in these windows. By looking through at a light source, the operation of the element may be clearly observed.

The condition of the trap seat should be checked whenever an element is removed, and if there is any sign of wire drawing, corrosion, or wear the seat should be replaced. The new seat must be set at the original level so that the element will have the proper travel. For the same reason the element must be firmly screwed into the cover, and the cover securely tightened. The practice of some engineers of placing a gasket under the cover results in waste of steam since a higher temperature is required to close the trap. If a cage type element is used, the original seat should be removed, and the cage gasket pressed firmly down on the bottom of the body. The distance from the top of the cage to the trap cover is unimportant since the travel of the element is fixed within the cage.

Thorough examination of elements should take place at regular intervals. In orifice and low differential systems checks may be less frequently made than otherwise, since the elements do not usually expand and contract so frequently. Where higher pressures are supplied with intermittent controls, elements expand more violently and should be tested more often.

Systems Using High Vacuums

For systems using high vacuums, especially when they are changed from low to high vacuum, care must be exercised to be certain that the element will close against steam at low temperature, otherwise much of the advantage of high vacuum will be lost. This is partially compensated for automatically in some trap designs since the reduced pressure on the exterior of the bellows permits the actuating liquid to expand


1" Connection to L.P. Steam Main
Pressure Gage
1/4" Water Connection
1" Globe Valve—(Union Connection Part of Valve)
1/4" Needle Valve
1" Horizontal Line with Slight Pitch Towards Trap
Mercury Thermometer with Shield
Special Tee Fitting
Sink—Connect Discharge to Waste
Test Trap

A test set for thermostatic radiator traps. (Courtesy Barnes & Jones, Inc.)

more readily. It is safest when purchasing elements to specify the conditions under which they will be expected to operate, and when testing, to simulate actual conditions as closely as possible. The discharge line from the test rack should be connected into the vacuum pump through a glass tube through which the trap action may be observed.

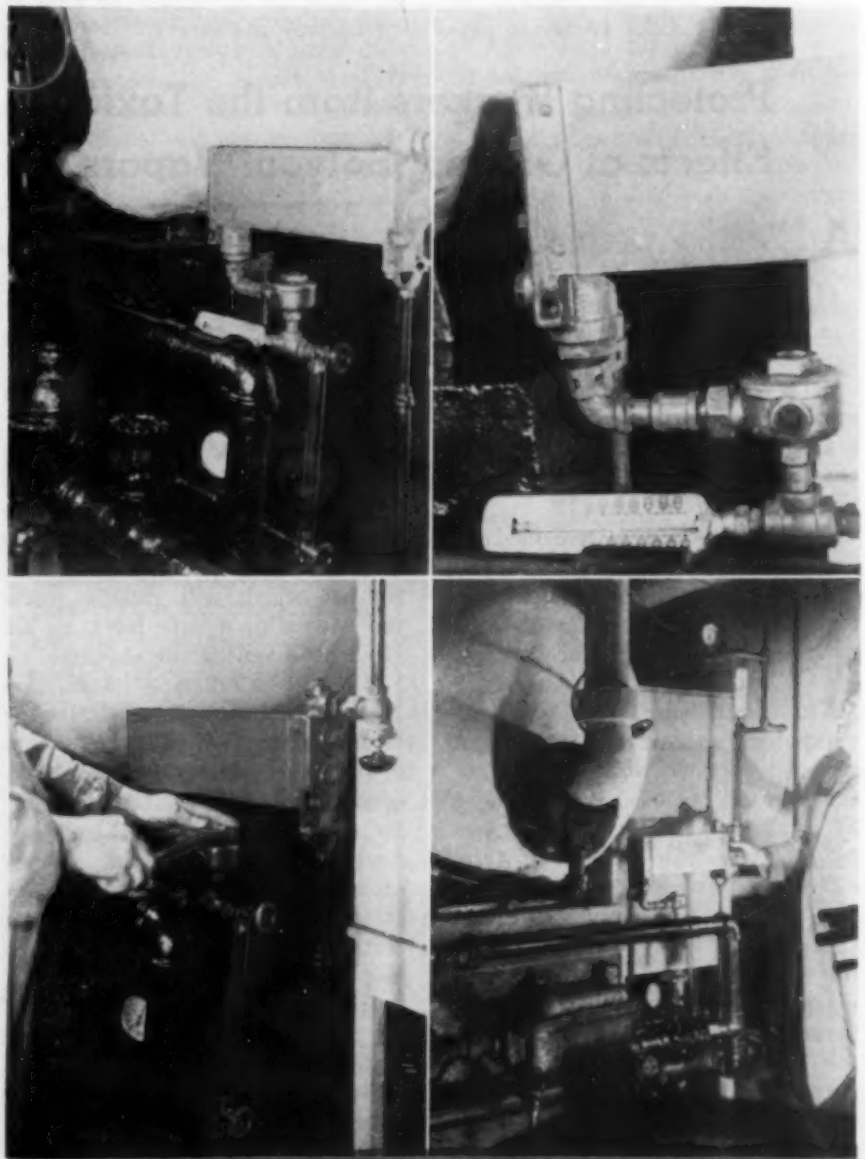
Each building should have an adequate set of tools, including socket wrenches with extension handles, so that inaccessible covers and seats may be easily removed and replaced. Radiator enclosures should be so designed that trap repairs can be readily made. In one building having builtin metal enclosures, access panels were made by cutting a 4 in. hole using a circular saw on an electric drill, and closing the hole with a cover made for capping unused electric ceiling outlets.

Trap Maintenance Saves Steam

Records of building steam consumption prove the desirability of trap maintenance in obtaining economical heating system operation. An outstanding example is a large apartment house equipped with an automatic steam control, but in which the steam consumption was gradually increasing. When the building was about 14 years old, a number of the elements were removed, tested, and found defective. All of the elements were then replaced, with the result that the steam consumption dropped from 4500 to less than 4000 lb per degree day.

The low points and ends of all mains, and the bases of risers which serve six or more stories or which have runout connections from the mains of over 6 ft, should have drip connections to remove accumulated condensation. Good practice dictates that each drip should be equipped with a ball float trap, but engineers differ as to whether such traps should have thermostatic bypasses so that air may be removed. If the return line for the drips is dry, circulation is improved by using the combination float and thermostatic trap. Separate drip returns should be provided for each section or zone so that steam that might reach the drip line in one zone will not affect the traps in another. Drip lines should be independent of radiator returns, and wherever practical the drip connections should not be tied in to the vacuum tank, since the hot condensate from drip traps may flash into steam at subatmospheric pressure, and then tend to kill the vacuum. A peculiar action sometimes occurs with thermostatic elements in drip traps, induced by the fact that when steam is turned off it continues to condense, forming a vacuum in the supply system which is higher than that in the returns. When the system begins to cool off, the thermostatic elements will open and air or water in the drip lines may be sucked into the supply, causing knocking or slow circulation on the next cycle.

A good method of checking the



Four views of a test setup for steam traps. There is a pressure gage and thermometer on the inlet side of a small radiator, with a trap body equipped with a glass window discharging through a glass tube. There is a thermometer and pressure gage on the discharge side of trap also

Experience has shown the value of regular, systematic inspection of traps to ascertain their effectiveness and responsiveness. One apartment building reduced steam consumption from 4500 lb to less than 4000 lb per degree day by replacing all defective radiator trap elements

operation of ball float traps is by means of test cocks or valves permanently installed with each trap. If the trap passes steam, it should be cleaned and the float checked for leaks. If it holds water, it is usually due to its being clogged with sediment, or it may be too small for the condensation load it is called upon to carry. This also applies to float traps used as return traps on gravity systems and to high pressure drip traps, the proper operation of which is vital to circulation and safety.

Protecting Workers from the Toxic Effects of Organic Solvent Vapors

ALL VOLATILE organic solvents, including gasoline, benzene (benzol), naphtha, carbon tetrachloride, and trichlorethylene, give off toxic vapors. Hence, workers using any of these solvents in cleaning, degreasing, cementing, and other operations must be protected from the effects of inhaling excessive amounts of their fumes.

Basic protection is provided by keeping the concentration of solvent vapors in the general atmosphere of the workroom below "the maximum allowable concentration (MAC) for continuous exposure."

This limit, which represents the maximum concentration of solvent vapor to which workers may be continuously exposed during the 8 hr work day, has been established by the American Standards Association for several of the commonly used solvents, but many states have standards of their own. The limits vary from 50 parts of solvent vapor per million parts of air for benzene to 1000 parts per million for petroleum products unmixed with more toxic substances. Solvent users can obtain MAC tables from the industrial hygiene departments of their respective states, or, in states without such departments, from the U. S. Public Health Service, Washington, D. C.

Natural ventilation may suffice to provide this basic protection where the contamination of the atmosphere is slight, as where the solvent is being used in small quantities or is applied in equipment that prevents the escape of vapor. In other cases, it may be necessary to employ some form of mechanical ventilation, such as a local system which will draw off the vapors as they arise or strong general ventilation which will rapidly dilute the vapors to a safe level, as advised by a ventilating engineer.

Working conditions in a plant are probably satisfactory if the air is free from the pronounced odor of the solvent being used; but since odor is not an adequate criterion, an atmospheric survey should be made. This requires the services of a competent chemist. In some states, such work is done by the state industrial hygiene department on request.

However, even where the workers as a group are effectively protected by these measures, certain individuals may be endangered by practices like the following:

Using solvents in poorly ventilated areas, such as small rooms, basements, pits, etc.

Applying solvents in close proximity to the face, as in spotting garments or cleaning floors or machinery.

Working over open containers of solvents.

Handling products damp with solvents.

Opening containers or equipment holding solvents in such a manner that high concentrations of the vapor are inhaled.

Permitting drafts to blow solvent vapors in the direction of workers.

Allowing persons to work with solvents to which they are abnormally sensitive.

Entering tanks containing solvent vapors without proper respiratory protection.

It is not enough to prohibit such practices. Workers must also be educated to the dangers involved, and constant supervision must be maintained to prevent any one from taking chances.

When workers are unavoidably subjected to excessive concentrations of solvent vapors, they should be protected with suitable gas masks. Where the vapor concentrations are relatively low, canister-type masks approved for organic vapors by the U. S. Bureau of Mines may afford adequate protection, but for high concentrations as in vapor filled tanks, approved air line respirators must be employed.—SAFETY RESEARCH INSTITUTE, INC.

NEW RADIATOR TAKES PLACE OF BASEBOARD

One of the most interesting new developments in the heating industry which will be available postwar is the floor level radiant heating system, says the Plumbing and Heating Industries Bureau, consisting of a hollow metal baseboard which takes the place of the conventional wood baseboard. The unit is installed around the exposed walls of the building.

While certain types of low level radiators were available before the war, the idea received recent impetus as a result of tests conducted in the IBR research home at the University of Illinois, where it has been found that the low source of radiant heat in the unit produces a uniform feeling of comfort among the occupants of a room. Remarkably small differences in temperature at the floor and at the ceiling level were observed; with outdoor temperatures of approximately 30 F, a ceiling to floor temperature difference of about 1.5 F was obtained.

AN EXPERIENCE REPORT:

Operation and Maintenance of Steam Piping at an Institution

By George Holman
Operating Engineer

AN AMAZING variety of problems is met with in the operation and maintenance of the extensive steam and condensate piping systems serving a large institution. This is an "experience report" by the man responsible for the equipment at one such building group, reviewing some of these problems — involving weaknesses in design of equipment, system layout, installation, and maintenance procedure . . . Original design and installation of a heating, piping, or air conditioning system in a plant or large building is but half the story. Continual operation and maintenance, and repair, alteration, and extension of these services, is required; this calls for a high degree of skill and good engineering practice if satisfactory results are to be had

AT A STATE institution, 500,000 lb of steam is generated daily at 150 psi boiler pressure. During the nonheating season, about 60 per cent of this is used for power generation, and the remainder used in laundry service, for cooking, pasteurizing milk, rendering lard, and for canning fruits and vegetables. During the heating season all of the exhaust, plus considerable quantities of live steam makeup, is used in an extensive low pressure heating system. Other piping systems for steam, at 80 psi, 70 psi, and 30 psi, are in continuous operation the year around, and furnish steam for the uses mentioned above, and for various detergency operations.

The problems arising in these steam piping systems, the solutions of these problems, and necessary changes from time to time after the systems were installed, doubtless are typical of those occurring in many such systems everywhere. There is an amazing variety, revealing weaknesses in design of equipment (kettle, Fig. 6, where erosion by entrained scale was not allowed for), in system layout (Figs. 1, 3a, and 4), in installation, and in maintenance (Fig. 2).

Operation and maintenance of these piping systems are complicated by the wide variety of types, sizes, and makes of equipment being used for identical purposes. This condition reflects lack of planning, lack of policy, and changing personnel among officials responsible for the purchase of equipment. Scarcely two pressure regulators, or two steam traps, or two vacuum pumps are exactly the same as to size, type, etc. This failure to standardize makes the keeping of repair parts for all equipment too costly.

As a result of this lack of spare parts, odd and sometimes intricate changes have been made in piping systems after their installation. Some of these changes were necessary. For example, a lone vacuum pump in the institution hospital had long operated by float control from the water in the condensate well. Then a pipefitter changed it to vacuum control at a time when a serious air leak had developed. Located in an uninspected section of the basement, the pump ran continuously until it burned itself out.

Fortunately, the hospital is on ground higher than the power plant. While waiting for repairs for the pump, pipefitters re-arranged the return line to carry the condensate back to the power plant hot well by gravity. Because there was no loss of heat by this change, and because the hospital heating system worked just as well, this temporary expedient was allowed to become permanent. Except for the problem shown in Fig. 2, this system has operated successfully without the pump. There is some doubt that it should have been installed at all.

An outright and hardly excusable error of installation came to light in a 4 in. line built to operate under 80 psi. This line was installed in 1938. It is 1500 ft long, and carries steam to a number of buildings, the foundations of which are approximately 100 ft above the floor level of the power plant. This new 4 in. line was connected into the old 2½ in. main in the buildings. Specifications called for a 2½ in. reducing valve. For reasons best known to himself, the contractor installed this 2½ in. valve through pipe reducers at a point in the underground duct very near the power plant, thus forming a bottleneck for the steam flow. At peak loads, the pressure could not be maintained.

There are no superheaters on any of the five water tube boilers of the power plant. While trapping off excess water just ahead of the pressure reducing valves does permit the steam to become slightly superheated during expansion, this small degree of superheat is soon lost. Water, the heat vehicle and natural residue in any steam heating system, begins to cause trouble below the regulators as well as above them. In fact, water begins to cause trouble even as it leaves the boiler by appearing as carryover heavily laden with solids or solid-forming impurities, and/or solvent or corrosive gases.

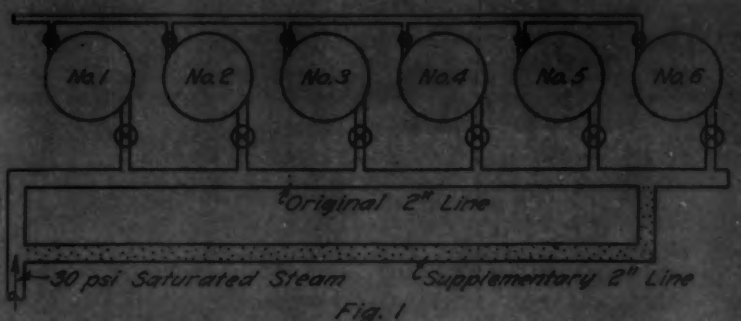


Fig. 1

Fig. 1—In this battery of kettles, fed through 1 in. branches from a 2 in. line, Nos. 5 and 6 raised cold water to the boiling point within 3½ min., while Nos. 1 and 2 required 10 min. This problem was solved by installing a secondary 2 in. line to supplement the original, and tapping in between kettles 5 and 6. With this arrangement, all kettles brought water from 65 F to the boiling point within 4 min

Fig. 2—Every troubleshooter knows that even in piping systems trouble is not always where you find it. When all radiators on the west side of the second floor of the three story institution hospital refused to warm up, pipefitters naturally suspected the radiators there, the thermal traps bleeding them, and the steam and condensate pipes connected to them. All other radiators in the building were hot. Yet these not only grew cold; they filled with water and hammered so loudly as to disturb patients in other rooms and on other floors. After considerable study, the trouble was located in the steam duct several feet outside the hospital (X on the sketch). The steam used for heating was exhaust from engines, and oil and sludge had precipitated in a low section of the condensate return line to partly obstruct the flow. The entire amount of condensate being formed could not get by, and the surplus was backed up into the radiators on the west side, where resistance to flow was greatest

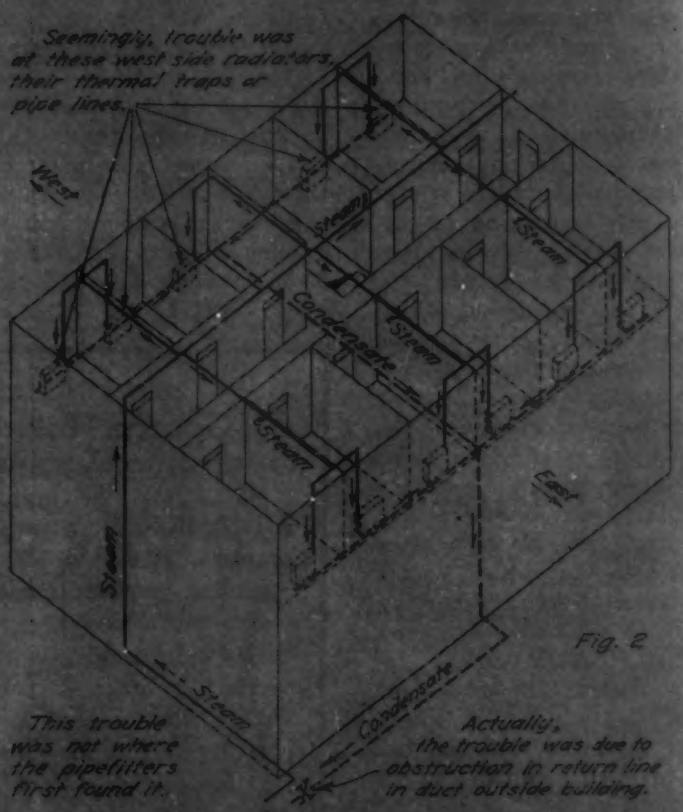


Fig. 2

Fig. 4—Concrete block support for this 8 in. low pressure steam line was more economical upon installation, but later proved more costly than hangers. Moisture in the pipe duct during non-heating season caused rapid corrosion of the pipe where it touched the concrete. This line was 200 yards long, and had numerous branch lines leading from it. It was repaired by cutting it into 50 ft sections with an acetylene blowpipe, and turned 180 deg with chain tongs. All branch lines had to be cut off and the tap holes closed by electric welding. Sheet copper was placed between the pipe and block. After turning, the line was again welded, the electric arc being used to conserve high priority acetylene and oxygen. The corroded surface was then brought up to normal strength and thickness by arc welding

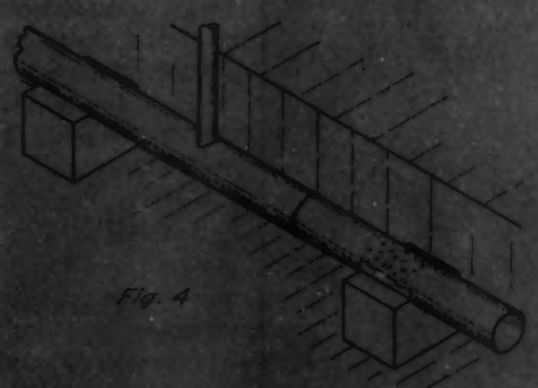


Fig. 4

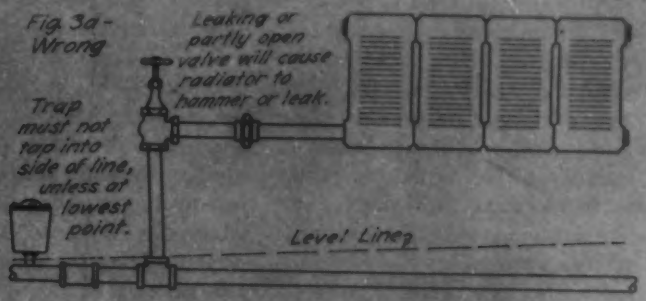
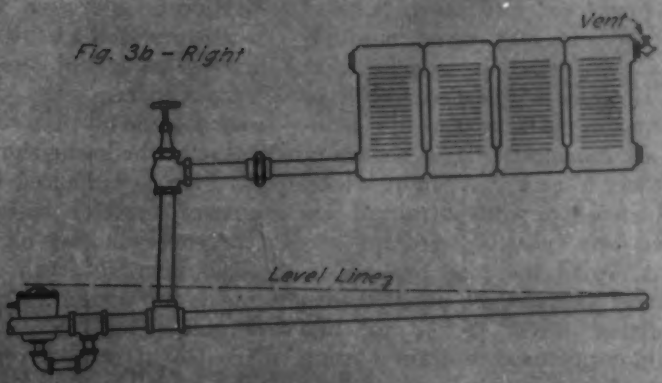


Fig. 3a - Wrong
Leaking or partly open valve will cause radiator to hammer or leak.
Trap must not tap into side of line, unless at lowest point.
Level Line

Fig. 3—Unvented radiator sagging at the blind end may air bind and/or chatter. The "one-way" heating system has many advantages generally admired by pipefitters. There is no separate condensate return line, with dozens of stop valves, check valves, unions, and thermal traps to service. One trap may be installed to serve a whole building or other heating area. Radiators may be more quickly removed for repair; and if properly installed are usually not so noisy, since there are no thermal traps to "flutter." However, the one-way system must be properly installed, or trouble will ensue. A vent cock, sometimes omitted in systems with a separate return line, is essential to prevent air binding. There can be no dips or rises in the pipe line to each radiator. Each radiator must slope toward the main line, and the main line must slope toward the trap. The valve must be either wide open, or tightly seated without leaking when closed



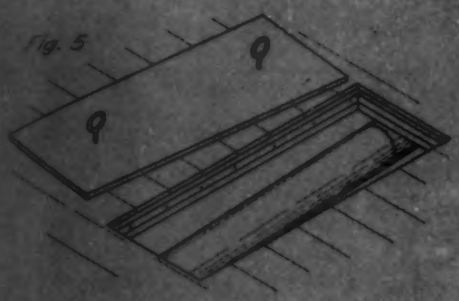


Fig. 5—To facilitate introducing or removal of pipe from ducts, a number of longitudinal manholes were left when the ducts were installed. Covers are drilled and tapped for ½ in. eye bolts for lifting. Under these manholes the insulation is protected from dripping water by a sheet metal covering

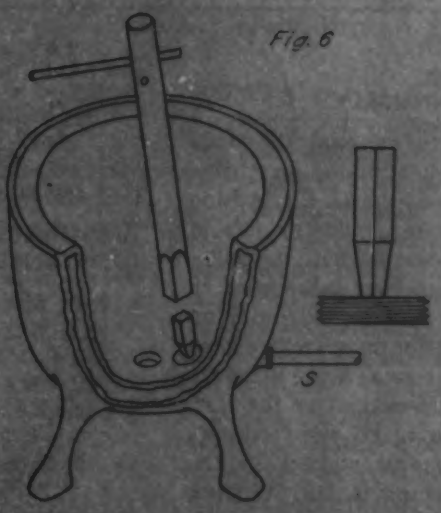
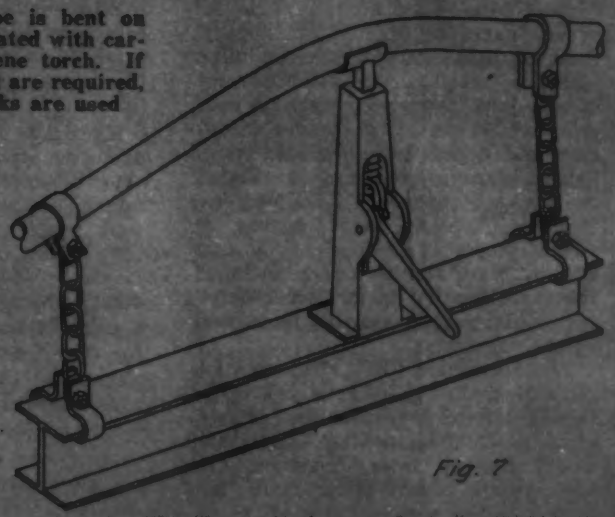


Fig. 6—Water and solids entrained in steam entering this kettle at S eroded an area roughly 4 in. in diameter in the inner shell opposite the steam inlet. It was repaired by reaming the hole true and tapping, then plugging, as shown in the sketch. The plug was faced smooth, and a temporary stem welded on. Threads were smeared with iron cement. An old piece of pipe, squared at one end, was used as a wrench for reaming, tapping, and screwing in the plug. The temporary stem was knocked off, and the surface smoothed with a portable grinder. This kettle was repaired for "temporary use" 10 years ago, but is still in service

Fig. 7—Large pipe is bent on this jig. Pipe is heated with carbon arc or acetylene torch. If bends of long radii are required, two or three jacks are used



In a well-maintained steam heating system water in itself is not especially troublesome. The substances it carries along in solution or mechanical suspension make it so. Oxygen, free carbon dioxide, the carbonates, sulphates, and chlorides commonly entrained in the condensate account for much of the deterioration of the return lines of this system.

Occasionally, the specific effect of corrosion in return piping is a single rifle cut into the bottom of the pipe and splitting it longitudinally. Observation reveals that this is common where return lines are much too large for the quantity of condensate it is necessary for them to carry. A slight trickle of condensate, with entrained corrosive and possibly erosive elements, ruins the pipe line as effectively as would be possible with a cutting torch. A ¾ in. line should not be used to drain a group of radiators yielding only a small amount of condensate, if a ½ in. line will suffice.

In this extensive and complex heating system corrosion is by far the most common cause of deterioration and failure in return lines. Sludge deposits also present major problems (Fig. 2), and even when oily seem to aggravate corrosion. Due to low pressure and low rate of flow, erosion in return lines is negligible.

However, erosion had worked with corrosion as co-causes of failures of globe and gate valves, pressure reducing valves, traps, vacuum pumps, and such pieces of equipment as the kettle shown in Fig. 6. Erosion is enhanced by the products of corrosion, by impurity-laden carryover and by high percentage (200 ppm) of scale forming elements in the make up feedwater. Probably 99 per cent of all the trouble at valves, regulators, and traps is due to erosion and internal corrosion.

While the solid particles which cause erosion and sludge precipitation are usually the products of erosion and corrosion, or derived from substances in solution in the feedwater, a noteworthy problem once arose in which these elements played no part. A battery of new radiators had been installed and connected by a "one-way" system. Although well vented, and with all other conditions of proper installation strictly adhered to, these radiators refused to heat. Apparently without cause, they clattered and knocked incessantly. Changing traps did not solve the problem. On opening a trap, however, pipefitters discovered a quantity of sand. Foundrymen had failed to properly remove the cores from their castings. Steam had dissolved them, and the sand had washed back to clog the one-way line.

SEES 400,000 STOKERS ANNUALLY

According to an analysis made by Herman E. Winkler, executive vice-president of the U. S. Machine Corp., the stoker industry should produce between 350,000 and 400,000 stokers per year subsequent to 1950 or 1951 and should build up to this production rate from a production of around 200,000 units during the first year after the war.

"We'll have more self-feed and more ash removal stokers in the future," according to Mr. Winkler, but they won't come quickly, in his opinion, as "there is a lot of inertia in the myriad forces that make up a product, starting from the drafting board and ending in the owner's hands."

CHANGES NAME TO STEEL BOILER INSTITUTE

The name of the Steel Heating Boiler Institute, Inc., has, by vote of the membership, been officially changed to Steel Boiler Institute, Inc. Its membership includes manufacturers of various types of steel heating and power boilers. For some time it has been thought that the use of the word "Heating" in the name implied restrictions on the products of the manufacturers which do not exist, because they make steel boilers for both low pressure heating and high pressure power and process use.

ANNOUNCES AWARDS FOR RESISTANCE WELDING PAPERS

The Resistance Welder Manufacturers Association, 505 Arch St., Philadelphia 6, Pa., has announced a $1000 prize contest "to encourage the preparation of outstanding papers dealing with resistance welding subjects." Complete information is given in a leaflet available from the RWMA. The contest closes July 31.

COAL USE RESTRICTED TO 80% OF NORMAL

Domestic consumers affected by the new retail coal delivery limitations of the Solid Fuels Administration for War, for the fuel year starting April 1, are persons who acquire solid fuels for use in a house, apartment house, prison, police or fire station, library, museum, bank, office or office building, store and retail service establishment of any kind (except commercial bakeries or laundries), passenger terminals and depots of all kinds; warehouses, garages, restaurants, taverns or bars, gymnasiums, auditoriums, theaters, club or lodge houses or rooms, places of amusement, dancing studios, zoos, stables and kennels, or for space heating in any other building or plant not specifically mentioned in the regulation.

The restriction (SFAW Regulation No. 26) applies to all retail deliveries in the territory east of the Mississippi and in Minnesota, North and South Dakota, Iowa, Louisiana and the city and county of St. Louis, Mo. It will be the responsibility of the retail dealers in that area to distribute consumer declarations to all domestic consumers (except those buying in less than quarter-ton lots) using solid fuels and to limit deliveries to 80 per cent of the consumers' normal annual requirements. No bituminous coal, coke, anthracite, briquettes and processed fuels may be delivered unless the domestic consumer files a declaration and an order with a retail dealer.

Exempted from this regulation are domestic and industrial consumers who receive 3000 tons or more of bituminous or sub-bituminous coal in a year from a retail dealer and who have facilities for storing at least a 15 day supply. The supply estimate must be based on the consumer's average daily consumption requirements for the period December 1944 to February 1945. Also exempt are the armed services, Veterans' Administration, commercial fishing, cargo or passenger vessels, hospitals and homes for the infirm, employees of producers living in the vicinity of a mine or colliery.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

The Influence of Heat Capacity of Walls on Interior Thermal Conditions and Heat Economy

C.-E. A. Winslow,* L. P. Herrington** and R. J. Lorenzi,† New Haven Conn.

SUMMARY—A report of tests and studies made to determine the influence of walls of moderate and high heat capacity upon interior thermal conditions and fuel consumption. Two types of wall construction were used, viz. ¾ in. of painted plaster on a 16-in. brick wall, and ¾ in. of painted plaster on wood laths nailed on a 2 in. x 4 in. stud framing the outside of which was covered with 1 in. wood sheathing and 1 in. painted cedar clapboards.

Conclusions are drawn for operation during periods of 20 F outside temperature and during cycles of external temperatures ranging from 10 to 30 F.

OBJECT *and Nature of Experiments.* The purpose of these studies, which have been conducted for the past two years at the John B. Pierce Laboratory of Hygiene, was to measure the influence of walls of moderate and of high heat capacity upon interior thermal conditions and fuel consumption.

The original experimental plant consisted of a two-room house of ordinary frame construction, surrounded by shell spaces, on all four sides and above the roof and below the floor, in which spaces temperatures could be maintained at any desired point, to simulate external weather conditions. The structure was of one-story, the two rooms being separated by an interior corridor four feet wide.

After completion of studies in the original frame rooms, the experimental house was reconstructed —one room with a high-capacity wall of 16 in. of brick, the other with a wall of very low heat capacity. The series of studies made on the frame structure have now been repeated with the brick room, and it is the comparison of results with these two wall materials which is presented at this time.

The general layout of the original experimental installation may be found in a paper by Winslow, Greenburg, Herrington and Ullman.[1]

The frame room had an interior length of 15 ft (East and West walls); a width of 12 ft (North and South walls); and a height of 8 ft. The walls on their inside surface were of ¾-in. painted plaster on wood lath. The laths were nailed to 2 in. x 4 in. stud framing, the studs being placed 16 in. on centers. The exterior surface was 1 in. of wood sheathing covered by 1 in. of painted cedar clapboards. In the South wall there was one window and in the East wall there were two windows. The windows were double-hung wood, with metal weather-stripping, 2 ft 6 in. x 4 ft 8 in., and had storm sash weather-stripped with ⅛-in. felt. The West wall (abutting on the interior corridor) was a standard inside partition of wood lath with ¾ in. of plaster on each side of 2 in. x 4 in. studding, with 1 in. of Celotex insulation added to the interior surface. The room had a double floor, an upper surface of 1 in. hardwood and a lower 1 in. of sub-flooring with a layer of heavy felt between. This double floor was nailed to 2 in. x 12 in. joists, 16 in. on center, providing a space of 12 in. between the bottom of the floor and a layer of metal lath and plaster separating this under-floor space from the controlled shell space beneath.

*Director John B. Pierce Laboratory of Hygiene. Member of ASHVE.
**Associate Director, John B. Pierce Laboratory of Hygiene.
†Staff Member, John B. Pierce Laboratory of Hygiene.
Presented at the 51st Annual Meeting of the American Society of Heating and Ventilating Engineers, Boston, Mass., January, 1945.

[1] Design and Equipment of the Pierce Laboratory, by C.-E. A. Winslow, Leonard Greenburg, L. P. Herrington and H. G. Ullman. (ASHVE Transactions, Vol. 40, 1934, p. 67).

During our experiments the floor was covered with a 12 ft x 15 ft Broadloom rug with a pad underneath, each about ⅜ in. thick. The ceiling of the room was of wood lath and ¾ in. plaster on 2 in. x 4 in. ceiling joists set on 21-in. centers. Above the lath and plaster were 4-in. batts of rock wool, and above the rock wool was a 34-in. attic space, separated from the controlled shell space above by a roof of 1-in. sheathing on 2 in. x 8 in. rafters, 21 in. on center.

The brick room was exactly the same except for the reconstruction of the three exterior walls and except for the fact that the Western instead of the Eastern room of the house was used for the study of brick reconstruction. Therefore, the wall with two windows was, in this case, the West wall and the wall of the interior corridor was the East wall. The brick room was designed so that its interior dimensions were almost exactly the same as those of the frame room (actually 15 ft 1 in. x 11 ft 10 in. x 8 ft). On the three exterior walls, ¾-in. painted plaster was applied directly to a 16-in. wall of brick. The inner 12 in. were of medium density brick, the outer 4 in. of medium high density brick. Since the interior dimensions were the same as those of the frame room, the brick structure projected out for a considerable distance into the North, South and West shell spaces, and the windows were set in alcoves when viewed from the shell space side. The exterior surface exposed to the controlled shell spaces was thus noticeably increased.

Since exact knowledge of heat input was essential for our purposes, electrical heating was used. The experimental rooms were heated by radiation from a series of banks of 250-w infra-red lamps with silver-necked reflectors, having filament temperatures at full wattage of 4000 deg. They were mounted in sheet metal reflectors, suspended from the upper part of the walls with the bases of the heater bulbs 7 ft above the floor. At the North and South ends of the room was one bank of 6 bulbs; on the East and West sides, three banks with a total of 14 bulbs for each side. The lamps on the North and South walls, and the center banks on the East and West walls were directed toward the floor, while the four end banks on the East and West walls were directed toward the ceiling, so that heat actually reached the rest of the room by radiation from the floor and ceiling.

Heat input was regulated by automatic control of voltage actuated by a thermostat whose element was installed in a black globe.

During the course of an experiment, continuous temperature records were made on Leeds and Northrup Multiple Point Potentiometer Recorders (Micromax type) from 32 recording points, which represented 130 couples of iron-constantan placed in the various shell spaces and in the room. They included, in most of the experiments here reported, 7 points in the air of the various shell spaces, 12 on the outside and inside wall and floor and ceiling surfaces, 2 on inside and outside window surfaces, 3 air and globe temperatures within the room, 6 points on a gradient through the North (windowless) wall (from inside air to outside air), and 2 ice bottle controls. In many instances, a single recording point averaged the temperatures registered by 4-8 thermocouples distributed over a given surface. On the interior surfaces of both rooms, the couples were imbedded in the surface of the plaster, and on the outside of the brick structure the junctions were placed in grooves 1/16 in. to 1/8 in. deep and 6 in. long. On the outside clapboards of the frame structure, however, the thermocouples were placed on the surface of the clapboards.

In general, experiments were made with a constant temperature (of 20 F and 40 F) in the three exterior shell spaces or else with a varying temperature in the shell spaces (10 F-30 F or 30 F-50 F), duplicating a diurnal cycle. In most instances the interior room temperature was stabilized at 70 F and, after this temperature was maintained at this level for 8 hours, the heating units were turned off and kept off for 8 hours to simulate a period of night-cooling. Where the outside temperature was cycling, this period of night cooling was synchronized with the coolest portion of the exterior cycle. In one experiment with the brick room, the windows were opened during the period of night-cooling. At the close of the cooling phase the heating units were turned on again and comfort conditions restored as promptly as possible.

Experiments were also made to reproduce summer conditions by varying the temperature of the three exterior shell spaces between 65 F and 95 F and back again in a regular diurnal cycle. In this case, of course, no heat was supplied to the room.

Finally, for some special studies on heat conductance and heat capacity, the interior of the room and all shell spaces except that outside the North wall were maintained at 90 F while the North shell space itself was kept at 10 F or 30 F. In this way we obtained a major temperature differential, with heat-flow only through the windowless North wall.

Heat Conductance and Heat Capacity of Wall Materials. With stable conditions inside and outside the experimental room, and with exact knowledge of the wattage input necessary to maintain such a stable relationship, it was possible to compute conductance values for the types of building materials involved on a larger and more practical scale than that provided by ordinary panel tests. Five satisfactory experiments were completed with this end in view for the frame and six for the brick structure. The interior temperature was 70 F and the outside temperature 40 F in Experiments Frame V and Brick I-A. The interior temperature was 70 F and the outside temperature 20 F in Experiments Frame VI and VII and Brick II. In these instances all three exterior shell spaces were cold. In Experiments Frame XIII and XIV and Brick V all temperatures except that of the North shell space were at 90 F, while the North shell space was at 10 F, 15 F, and 30 F, varying in the different experiments. This set-up should, of course, be the most accurate since the North wall has no window and since heat interchanges through other surfaces were relatively slight.

For a given period of five experi-

ments with the frame structure and for six different periods in three experiments with the brick structure, the exact wattage required to maintain a differential of 1 deg between inside and outside air and between inside surface and outside surface was known. From the total amount of heat supplied to the room were subtracted the computed losses by leakage and computed losses by conductance through windows, floors, ceiling and interior wall (and in the case of Experiments Frame XIII and XIV and Brick V, also through the two exterior walls not subjected to cooling). Appropriate conductance values given in the HEATING, VENTILATING, AIR CONDITIONING GUIDE, corrected for actual shell space air velocities, were used in these computations; from the nature of the experiments, these losses were relatively small. The total wattage input less the losses by windows, floor and ceiling conductance gave the flow of heat through the wall structure under study. The results of these eleven experiments are summarized in Table 1.

The first and fourth columns of figures in this table show the theoretical conductances of the frame and brick structures as computed from the Guide tables. The third and sixth columns show the conductance values actually observed when computed on the internal surface area of wall. It will be noted that, in the case of the frame structure, these values are 23 per cent in excess, and in the case of the brick structure, 34-37 per cent in excess of the theoretical value. It is, however, from its outer surface that a building loses heat, and while the difference between inside and outside surface is relatively slight in a large structure, it is considerable in a two-room house. In the second and fourth columns, computed conductance figures were based on the mean between the inside surface area and the corresponding total outside surface area exposed to cooling (including, of course, the overlap at the top of the sides and around the windows in the case of the brick room). These figures check closely with theoretical values, being very slightly higher in the case of the frame and practically identical in the case of the brick structure. The general mean figures for all experiments, when computed on mean wall area, are as follows:

		Coefficients Btu/(hr) (sq ft) (°F) Surface-to-Air-to-Air Surface
Frame:	Theoretical.	0.22	0.30
	Observed .	0.24	0.32
Brick:	Theoretical..	0.29	0.43
	Observed ..	0.29	0.44

Thus, the brick wall has a surface-to-surface coefficient about 37 per cent higher than that of the frame wall.

Heat capacity was determined for the frame structure from the data of Experiment XII, in which the outside shell spaces were cycled between 65 F and 95 F for two complete cycles. Four periods were selected, during each of which heat was flowing in the same direction through both interior and exterior surfaces. For each of these periods the amount of heat transferred between shell space and outside wall surface (per square foot) and the amount of heat transferred between room air and inside wall surface was estimated from the film coefficients given in THE GUIDE (1.75 for outside frame surface and 1.52 for inside plaster wall). The net excess heat flow into or out of the wall for the period was then divided by the net change in wall temperature in the same period (determined by the mean of the change in inside wall temperature and outside wall temperature during the period). This procedure gave values ranging from 2.0 to 3.0 with a mean of 2.6 Btu per (sq ft) (deg F change in temperature). This compared with a theoretical figure of 2.56 for a wall of generally corresponding structure.

A similar analysis was made of the results in Experiments VI with the brick structure which yielded a figure of 37.6. The soundness of this procedure was considered doubtful because of the fact that the GUIDE coefficients are based on surface couples and those used by the authors, in the case of the brick structure, were both imbedded. In the case of the frame room, the error due to the interior imbedded couple could not be quantitatively great. For the brick room a more accurate approach was obtained from the data of Experiment V. Here there were two conditions of stability; first, with an exterior temperature of 14 F, and second, with an exterior temperature of 40 F—the interior of the room being kept at 90 F throughout. Between these two stable phases there was a heating-up period of 67 hours, which gave an admirable measure of heat capacity. In this case, however, it was first necessary to determine actual film coefficients for the inside and outside walls under the conditions of the experiment. It was found that the outside coefficients in THE GUIDE, in this case, yielded quite unreasonable results. This is to be expected since THE GUIDE film coefficients are not only based on surface thermocouples, but also on a wind velocity of 15 mph. In the case under consideration, the fact that the couples were imbedded in the walls would tend to give lower coefficients. In Experiment V, too, the inside wall was warmed by radiation from the warm ceiling and walls, and this would tend to raise the interior coefficient, while the outside surface was radiating to the cold outer wall of the shell

Table 1 — Conductance Values
Btu/(hr)(sq ft)(°F)

Experiment	Air-to-Air Coefficients[a] Observed: Theoretical	Observed: Based on Mean Surf.	Observed: Based on Int. Surf.	Surface-to-Surface Coefficients Observed: Theoretical	Observed: Based on Mean Surf.	Observed: Based on Int. Surf.
Frame V	0.22	0.25	0.29	0.30	0.33	0.38
VI	0.22	0.25	0.28	0.30	0.33	0.38
VII	0.22	0.24	0.28	0.30	0.32	0.37
XIII	0.22	0.24	0.27	0.30	0.32	0.37
XIV	0.22	0.22	0.25	0.30	0.29	0.33
Brick 1-A						
Phase 1	0.29	0.29	0.39	0.43	0.44	0.60
Phase 2	0.29	0.30	0.41	0.43	0.46	0.62
Brick II						
Phase 1	0.29	0.29	0.40	0.43	0.46	0.62
Phase 2	0.29	0.30	0.41	0.43	0.46	0.63
Brick V						
Phase 1	0.29	0.29	0.37	0.43	0.44	0.55
Phase 3	0.29	0.28	0.35	0.43	0.42	0.53

[a]Based on shell-space air velocity of 100 fpm and still air inside.

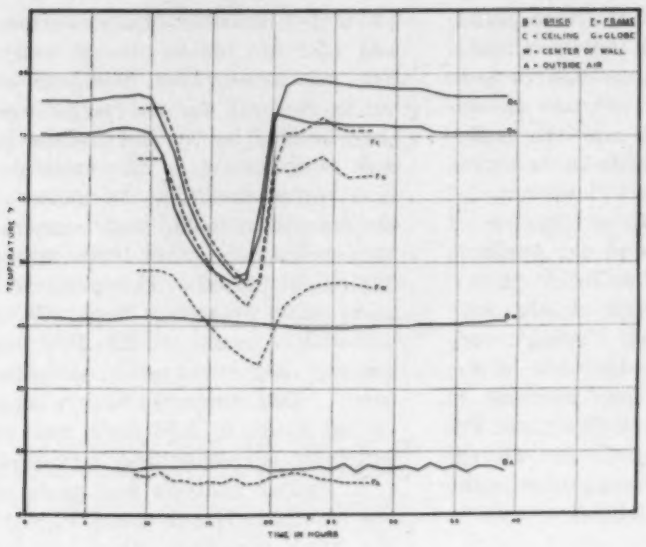


Fig. 1 — Mean hourly average temperatures of ceiling, globe thermometer, center of wall and outside air for experiments Frame VI and Brick II

space, which would tend to lower the exterior coefficient.

The actual film coefficients obtained in the experiments were computed for the two stable phases of Experiment V from conductance values from surface to surface (0.43), and from air to air (0.29), as in Table 1, and from the actual temperature differential from outside surface to inside surface, and from outside air to inside air. The mean values obtained were 1.49 for the outside film coefficient and 1.55 for the inside film coefficient. Using these new film coefficients, the heat transfer from the outside wall to the shell space for the 67 hours of heating-up was subtracted from the heat transfer from room air to inside surface and divided by the temperature rise of the wall (mean of inside and outside surface) to give the heat capacity per square foot of wall. The resulting value was 33.4. The value of 37.6 obtained by a cruder procedure from the data of Experiment VI was closer to the theoretical value of 36.8; but for the brick used 33.4 is presumably correct. A heat capacity of 33.4 Btu per (sq ft) (deg F change in temperature) for the brick wall as compared with 2.6 Btu for the frame wall, shows a heat capacity about thirteen times as great with only a 37 per cent greater conductance value.

Comparative Performance of Frame and Brick Walls with a Constant External Temperature of 20 F. A few typical experiments may be cited to illustrate the comparative performance of the two structures studied. Fig. 1 presents mean hourly average figures for Experiment Frame VI and Experiment Brick II, obtained at four of the 32 points at which temperatures were recorded. The two upper curves represent the temperatures of the ceiling surface from which most of the heat was radiated to the room. The second pair of curves represent the mean Globe temperatures in the center of the room. The third pair represent the temperatures in the center of the actual wall structure itself (windowless North wall). The lowest curves represent the temperatures of the air in the shell space outside this North wall.

It will be noted that the shell space temperature varied between 22 and 23 F in the case of the brick structure, and between 20 and 22 F in the case of the frame structure.

During the first stable phase, the ceiling was between 79 and 81 F in both instances, while the mean Globe temperature was 75.5 F for the brick and 71.5 F for the frame room. This difference in Globe temperature was due to the fact that in the frame experiment the shell space was a little cooler and the ceiling temperature a little lower.

Globe temperatures in the frame room represent the mean of two Globe thermometers at 30-in. and 60-in. levels; in the case of the brick room, a single reading was obtained by averaging the temperatures recorded by four Globe thermometers at levels of 6 in., 30 in., 60 in., and 90 in. above the floor. Special check readings showed that when the heating lights were on, the high temperatures of the 90-in. Globe raised the general mean about 1 deg above the mean of the 30-in. and 60-in. levels. Therefore, in the diagrams here presented, the Globe values for the brick room, when the heat is on, are about 1 deg too high for accurate comparison with the Globe values for the frame room.

Between the 10th and the 11th hours for the brick room (the frame experiments began only on the 9th hour of the schedule on which Fig. 1 is plotted), the lights were turned off for the period of night-cooling. In the next 7 hours when the lights were off, the Globe temperature dropped 23-24 deg in both experiments.

When the heating units were turned on again (between the 17th and 18th hours for the brick room and one hour later in the corresponding cyclical phase for the frame room), the temperatures rose rapidly. By the 20th hour the Globe temperature of the brick room had reached a maximum of over 78 F, falling later to a level of 75.5 F, the same as its initial value. The Globe in the frame room rose more slowly (less heat being applied) to 72 F at the 24th hour, falling later to a level of 68.5 F, 3.5 deg lower than its initial value. The heat input to the frame room at the close of this experiment was not quite enough to cause it to reach the initial temperature.

The curves for the center of the wall structure are of special interest. It will be noted that in the frame structure the center of the wall (mean of those surfaces of the interior lath and of the exterior sheathing facing each other across the stud space) fell from 53.5 F to 38.5 F and rose again to 52.0 F (the heat capacity not being fully satisfied at the end of this experiment, as pointed out above). In the case of the brick room, on the other hand, the temperature at the center of the brick wall fell only from 46 to 44.5 F, rising again to 46 F at the close. Practically the entire change in room temperature during the cooling period was ab-

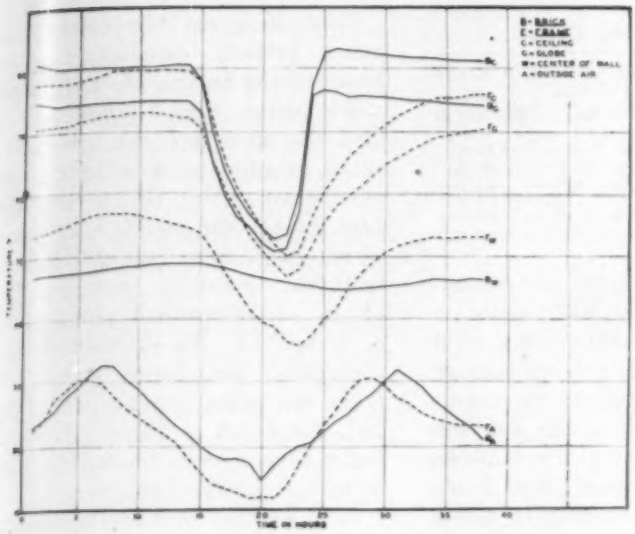


Fig. 2 — Mean hourly average temperatures of ceiling, globe thermometer, center of wall and outside air with external temperature passing through regular diurnal cycle

sorbed by the interior half of the brick structure.

Experiment Brick II, as discussed previously, was exactly duplicated in Experiment Brick VII, except that during the night cooling phase the top sash of one of the windows on the West wall was lowered 8 in. and the bottom of the South window was raised 8 in. Both experiments were very successfully controlled, the Globe temperatures being 75.5 F for the closed-window room, both in the initial and final phases, and for the open-window room, 72.5 F during the initial and 72.0 F during the final phase. Both experiments were sufficiently prolonged to insure final stability of room conditions, including an 8-hour preliminary stable phase, 8 hours of cooling, 5 hours of heating-up, and 12 hours for reaching stability.

The effect of the more rapid cooling due to the open windows on Globe temperature is indicated in the tabulation given as follows:

Globe Temperature (Deg F) in Brick Room with Windows Closed and Windows Open During Night-Cooling Phase

	Initial Stable Value	After First 3 Hours of Cooling	After First 3 Hours of Minimum	After First 3 Hours of Heating	After First 3 Hours of Maximum	Final Stable Value
Windows Closed	75.5	59.5	51.5	78.5	78.5	75.5
Windows Open	72.5	41.5	37.0	73.5	73.5	72.0

With the windows closed, the Globe temperature fell 16.0 deg during the first three hours of cooling and finally reached a minimum of 51.5 F; with the windows open, the fall for the first three hours was 31.0 F, and the final minimum, 37.0 F. The greater heat supplied by the regulators during the first three hours of heating-up raised the Globe temperature in the closed-window room 27.0 deg and in the open-window room 36.5 F. This is an interesting example of the flexibility of the system of heating employed. The minimum Globe temperature was 37.0 F, as shown. The heating units were turned on at a little before 8 A.M. The Globe temperatures (deg F) recorded for the subsequent 15-minute intervals were as follows:

8:00	39.5
8:15	51.0
8:30	65.5
8:45	71.5
9:00	74.5

Heating of this sort can be turned on and off like a light, and rooms allowed to cool at night can be made comfortable in half an hour.

There was, however, one other important result of the open-window experiment. With windows closed, the night-cooling phase reduced the temperature at the center of the brick wall from 46.0 F to 44.5 F, and at the close of the experiment this temperature had risen again to within a fraction of a degree of its original value. With the windows open, on the other hand, the temperature of the center of the brick wall fell from 46.5 F to 42.5 F, and at the close of the experiment—after 22 hours of heating—this value was still below 44.0 F. The high heat capacity of the brick wall causes it, as it were, to store cold during the phase of night-cooling. The effect of this accumulated heat deficit upon heat economies to be effected by night-cooling will be discussed in a later paragraph.

Comparative Performance of Frame and Brick Walls with Cycling External Temperature. Fig. 2 shows the data obtained with an external temperature passing through a regular diurnal cycle, the night-cooling phase being timed to come at the low point of the cycle. The chief purpose of this study was the determination of the economy effected by night cooling under such conditions, but a few words may be said in general comments on the results obtained.

It will be noted that the external shell-space temperature started in both experiments close to 23 F. Over a period of 5-6 hours, this temperature was raised to 33.0 F for the brick room and 31.0 F for the frame room. Then, over a period of 13-14 hours, it was dropped to 15.0 F for the brick room and 12.0 F for the frame room. It was then raised, over a period of 8-11 hours, to 32.0 F for the brick room and 31.0 F for the frame room, and finally lowered again to about 23.0 F for both rooms.

Fig. 2 shows how the interior cooling phase was superimposed on this exterior weather curve. It should be noted, however, that the study on the frame room was conducted in an early period of the studies, when the heating-banks and regulating system were designed to produce a slow and gradual heating-up after the cooling phase. The difference in the heating-up phase between the two structures was due to this difference in technique and not to any intrinsic difference between the brick and frame walls. The course of the cooling phase is almost identical in the constant and in the

Temperatures (Deg F) at Various Points on Cooling Cycle				
	Air Temperature External Shell	Mean Globe Temperatures, Center of Room Initial	After 3 Hours	
Structure	Space	Stable Phase	of Cooling	Minimum
Frame	20	71.5	57.5	48.0
	12-31	72.5	60.5	47.5
Brick	20	75.5	59.5	51.5
	15-33	75.0	59.5	51.5

cycling experiment as in the tabulation above.

The change in the temperature of the center of the wall structure may be summarized as follows:

Temperature at Center of Walls at Various Points				
		Interior of Room		
	External Shell	First		Second
Structure	Space	Maximum	Minimum	Maximum
Frame	20	53.5	38.5	52.0
	12-31	57.0	36.0	55.5
Brick	20	46.5	44.5	46.0
	15-33	49.0	45.0	46.5

The swing between maximum and minimum center-wall temperatures for the frame structure was 15 deg with constant outdoor temperature, and 21 deg when the interior cooling phase coincided with a low part of an exterior diurnal cycle. The corresponding swings for the center of the brick wall were 2.0 and 4.0 deg.

Heat Economies Accomplished by Night Cooling. One primary objective in this study was to determine the economy of fuel which could be attained by turning off heat during a period of night-cooling, as related to the heat capacity of the wall structure. It was assumed that during this cooling period of eight hours the inside temperature could be allowed to drop to 50 deg without danger of local freezing of plumbing, and the control mechanism provided for turning on enough heat during this phase to avoid dropping materially below that figure.

During the actual period of cooling there should be a saving of one-third of the total daily heat input needed for a given outside temperature, but, obviously, additional heat must be supplied during the subsequent heating-up phase to satisfy the heat capacity of air, furniture, and structure. The balance between these two factors has been worked out in Tables 2 and 3.

Table 2 summarizes our computation of the excess heat needed to compensate for night-cooling with the frame and the brick structure under different atmospheric conditions (20 F, 40 F, cycles between 10 F and 30 F, and cycles between 30 F and 50 F). Lines 3-8 of Table 2 show the steps leading to determination of the wattage necessary to maintain 1 deg differential between inside and outside air under stable conditions. In Experiments Frame IX and Frame XI no stable phase was maintained, and the figure in Line 8 for these experiments represents the mean of the values obtained in Experiments Frame I and Frame VI.

Line 10 gives the total watt-hours actually supplied for the hours of the heating-up and second stable phase (Line 9). Lines 11-13 give the mean temperature differential existing between inside and outside air during this period, and Line 14 the theoretical watt-hours which would have been required to maintain stability during this phase, as determined from Lines 8, 9, and 13. By subtracting the theoretical watt-hours (Line 14) from the actual watt-hours (Line 10), the result is the excess watt-hours consumed in the satisfaction of heat capacity (Line 15).

It is realized that in the case of the brick structure at least, the figure obtained in Line 15 is somewhat less than the true value, since even after two cycles had been completed, the temperature of the wall structure was still falling slightly. The error due to this cause can hardly, however, be large. In Experiments I-A and II the final stable values for brick-plaster

Table 2—Summary of Actual Power Requirements

	Frame Structure				Brick Structure			
1. General Conditions..	40F[a]	30-50F	20F	10-30F	40F	30-50F	20F	10-30F
2. Experiment Number.	I	XI	VI	IX	I-A	IV	II	III
3. Hours, Stable Phase	4–17	—	1–2	—	1–9	1–7	1–10	1–7
4. Mean Watts, Stable Phase	1029	—	1580	—	1360	1330	2269	2256
5. Mean Inside Air, Stable Pnase	69.3	—	69.7	—	71.3	70.6	74.1	73.8
6. Mean Outside Air, Stable Phase	37.9	—	21.2	—	40.3	40.4	21.9	20.7
7. Temp. Differential..	31.4	—	48.5	—	31.0	30.2	52.2	53.1
8. Watts/°F Differential	32.8	32.7	32.6	32.7	43.9	44.0	43.4	42.5
9. Hours, Heating and Second Stable Phase	—	24–41	10–19	22–38	18–49	29–44	19–44	30–45
10. Total Watt-Hours, Heating & 2nd Stable Phase	—	17190	19806	25840	49650	27033	68867	43728
11. Mean Inside Air, Heating & 2nd Stable Phase	—	64.8	65.1	62.3	71.0	70.9	74.4	72.4
12. Mean Outside Air, Heating & 2nd Stable Phase	—	42.9	19.8	24.7	40.2	44.7	21.6	23.8
13. Temp. Differential ..	—	21.9	45.3	37.5	30.8	26.2	52.8	48.6
14. Theoretical Watt-Hours Heating and 2nd Stable Phase ...	—	12890	14768	20902	43268	18445	59580	33048
15. Excess Watt-Hours to Satisfy Heat Capacity (10-14)	3443	4300	5038	4938	6382	8588	9287	10680

[a]The Stable Phase, in this case, was not at the beginning of the experiment which began with heating-up.

Table 3—Estimate of Saving by Night-Cooling

	Frame Structure				Brick Structure			
1. General Conditions ..	40F	30-50F	20F	10-30F	40F	30-50F	20F	10-30F
2. 24-Hour Differential	30.0	30.0	50.0	50.0	30.0	30.0	50.0	50.0
3. Total Watt-Hours, without Night-Cooling	23616	23544	39120	39240	31608	31680	52080	51000
4. Temp. Differential, Stable Phase	30.0	26.5	50.0	46.5	30.0	26.5	50.0	46.5
5. Total Watt-Hours, Stable Phases (16 hours)	15744	13865	26080	24328	21072	18656	34720	31620
6. Excess Watt-Hours, Cooling Phase	0	0	0	480	0	0	990	1040
7. Excess Watt-Hours, Heating-up Phase ...	3443	4300	5038	4938	6382	8588	9287	10680
8. Sum of (5), (6), and (7)	19187	18165	31118	29746	27454	27244	44997	43340
9. Per Cent Saving by Night-Cooling	18.8	22.8	20.5	24.2	13.1	14.0	13.6	15.0

contact and center-of-brick were less than 1 deg below the preliminary figure.

Table 2 represents the direct results of experiment. In Table 3 an estimate was made of the watt-hours saving accomplished by a period of night-cooling under four specific external air conditions with each structure on the basis of the data in Table 2.

Line 3 of Table 3 shows the watt-hours required to maintain (under conditions of Line 1) an interior temperature of 70 F for 24 hours (Line 8 of Table 2 multiplied by Line 2 of Table 3 and by 24).

In Line 4 are indicated the mean temperature differentials maintained between inside and outside air during the 16 hours of the stable phase preceding the following night cooling. For the experiments with constant external temperature, the figure is, of course, the same as that in Line 2. With outside cycling, the figures in Line 4 are computed as the difference between 70 F and the mean exterior temperature (in a cycle between 10 and 30 F or 40 and 50 F) in that part of a regular symmetrical cycle which begins four hours after the minimum and extends to four hours before the next minimum. The assumption is that the eight hours of night-cooling would cover the four hours on each side of the minimum point.

In Line 5 the number of watt-hours needed during this interior stable phase is obtained by multiplying Line 8 of Table 2 by Line 4 of Table 3 and by 16.

Table 4 — Summary of Temperatures Under Summer Conditions— Degrees Fahrenheit

	Outside Air		Center of Wall		Inside Air	
	Frame	Brick	Frame	Brick	Frame	Brick
Start of Experiment	63.0	65.5	62.5	65.0	62.0	65.0
Hour of 1st Maximum	13	13	16	20	19	21
First Maximum	94.5	95.5	79.5	72.0	75.0	71.0
Hour of 1st Minimum	25	25	28	29	28	28
First Minimum	63.0	67.5	67.5	70.5	68.5	70.5
Hour of 2nd Maximum	36	37	38	45	41	45
Second Maximum	94.5	92.5	81.0	74.5	76.5	73.0
Final Figure	63.5	65.0	68.5	73.5	70.0	73.0

In Line 6 is given the additional watt-hours actually supplied during the cooling phase (to maintain an interior temperature not below 50 F). Line 7 shows the additional watt-hours required for heating-up (as derived in Line 15 of Table 2). Line 8 is the sum of Lines 5, 6, and 7. Line 9 gives the percentage saving accomplished by night-cooling, as computed from Lines 3 and 8.

It will be noted that, contrary to views which are often expressed, the practice of permitting the structures studied to cool down to a minimum of 50 F at night effects substantial fuel economy. The economy increases with the coldness of the external environment (20 F as compared with 40 F), and it is greater when the cooling is permitted at the trough period of a cycling outdoor temperature than when it occurs during a period of constant outdoor temperature (10-30 F and 30-50 F, compared with 20 F and 40 F).

The saving ranges from 18 per cent to 24 per cent for the frame structure, and from 13 per cent to 15 per cent for the brick structure.

During the cooling phase the same direct saving of the heat supplied is effected with either wall, and both walls become chilled—the frame wall even more than the brick wall. In the case of the brick, however, there is a much greater heat-capacity to be saturated when the heat is turned on again, and in this process more of the heat saved must be expended during the warming phase.

Two factors must be taken into account in considering possible practical applications of these findings. In a large structure the factor of heat capacity (other than in walls) might be great, and economy by night-cooling would be correspondingly reduced. Furthermore, the method of heating employed was such as to avoid the losses of efficiency which accompany the use of many heating systems on an on-and-off basis.

The Influence of Heat Capacity on Comfort Conditions in Hot Weather. It is obvious that the heat capacity of wall structures has a marked influence on the degree of protection afforded against high daytime temperatures in summer. Brief reference may be made to this point.

This type of observation is illustrated in Fig. 3 for Experiments Frame XII and Brick VI. In each case, external temperatures in the three shell spaces were varied in a regular diurnal cycle between 65 and 95 F—no heat, of course, being supplied to the interior of the room. The shell space below the floor was maintained at about 55 F to represent the cooler soil, and the temperature of the space above the ceiling was allowed to drift with the changes accompanying the diurnal cycle in the shell space.

Reference to Fig. 3 and to Table 4, which summarizes some of the salient points, will make the findings clear. It will be noted that tests were begun with all temperatures—inside and out—in the neighborhood of 65 F. The outside shell spaces were then cycled up to 95 F and down to about 65 F in

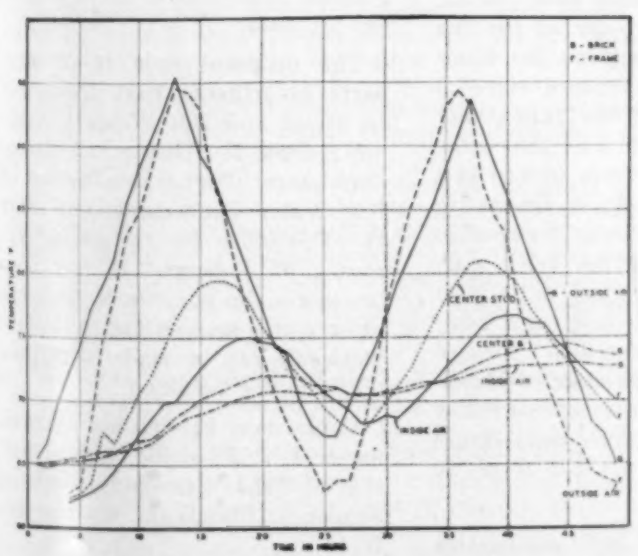


Fig. 3—Influence of heat capacity on comfort conditions in hot weather

two successive diurnal cycles. In the case of the brick room, the minimum attained at the close of the first cycle was 4.5 deg higher than that in the case of the frame house; otherwise the two experiments were closely comparable.

The temperature at the center of the wall structure followed that of the outside air with an interval of 2-3 hours in the case of the frame room, and 4-8 hours in the case of the brick room. The swing between maximum and minimum was about 30 deg for the outside air; 12.0 deg for the center of the frame wall, and 1.5 deg for the center of the brick wall.

The swing in temperature of the inside air (which followed by 1-3 hours the center-wall temperatures) was only 6.5 deg for the frame room and only 0.5 deg for the brick room. In the frame room the temperature fell at night to 68.5 F and rose to a maximum of 76.5; that of the brick room fell to 70.5 F and rose to 73.0 F. The second maximum was, in each instance, 1-2 deg higher than the first maximum, showing a slight heating-up of the total structure. Both walls give considerable protection against external daytime summer heat, but the brick room, with its maximum of 73.0 F, is, of course, most favorable. It is also important to note that the second maximum peak in the frame room came only five hours after the external peak period; while with the brick room the peak of inside air temperature came eight hours after the peak of external temperature—at a time when open windows could relieve the situation further. Obviously, these conclusions apply only to a climatic condition which involves a marked drop of temperature at night. Also, our results were obtained with a continuously cool under-floor space. It must also be pointed out that solar radiation did not enter into our experimental picture, and such radiation would, in itself, tend to create a greater inequality between day and night.

Clearly, the brick walls gave some added protection against external cycles of high temperature under the conditions of our experiment, but the surprising thing, perhaps, was the good performance of the frame structure. Even in the frame room an external diurnal maximum of 94.5 F was held down to 76.5 F.

Summary of Conclusions

1. Determinations of heat conductance and heat capacity values for frame and brick walls have been made in full-scale rooms under a variety of controlled experimental conditions. The conductance and capacity results for the brick wall check exactly with theoretical values, and for the frame wall deviate by less than 10 per cent from these results. In order to obtain significant conductance results with a two-room, one-story isolated structure, it is, however, necessary to use the mean areas of the exposed wall structures and not their interior areas.

2. Studies were made with walls having the following characteristics:

	Heat Conductance, Surface-to-Surface Btu/(sq ft) (hr) (° F)	Heat Capacity Btu/(sq ft) (° F)
Frame Room	0.32	2.6
Brick Room	0.44	33.4

These rooms were observed with continuous external temperatures of 20 F and with external temperatures cycling between 10 and 30 F. When interior heat sources were cut off for an 8-hour period of night-cooling, the inside Globe temperature dropped off at the end of 8 hours in both structures to a temperature of about 50 F. If two windows of the room were opened, eight inches each, one at the top and one at the bottom, the minimum temperature reached was 37.0 F. The center of the frame wall fell from 53.5 to 38.5 F; the center of the brick wall from 46.0 to 44.5 F. Almost the entire change in room temperature was absorbed in the inner half of the brick wall. The electrical heating units (set up to provide reflective panel heating from ceiling and floor) were so efficient that at the close of a cooling phase in the open-window brick room, the Globe temperature rose from 39.5 to 65.5 F in 30 minutes.

3. A series of eight comparable experiments indicated the saving of heat-input accomplished by an 8-hour period of night cooling to 50 F after due allowance for the additional heat supplied to satisfy heat capacity demands. The saving was 13-14 per cent of the heating load needed to maintain 70 F for 24 hours in the case of the brick structure, and 19-24 per cent in the case of the frame structure. The saving becomes greater with lower external temperatures and is greater when heat is turned off in the cold phase of a diurnal cycle than in the case of constant outside temperature. The decrease of economy with a structure of high heat capacity is noteworthy.

4. Under summer conditions of high outside temperature, cycling between 65.0 F and 95.0 F, both wall structures gave a high degree of protection. Maximum outside temperatures of 94.0 F on such a cycle gave maximum Globe temperatures of 76.5 F for the frame structure with a lag of 5 hours, and maximum Globe temperatures of 73.0 F with a lag of 8 hours for the brick structure.

CONVECTORS—TESTING AND RATING

The National Bureau of Standards has issued a Proposed Code for Testing and Rating Convectors which has been sponsored by the *Convector Manufacturers Association* and the Institute of Boiler and Radiator Manufacturers. The proposed standard is issued in mimeographed form and is dated February 19, 1945.

The proposed code is in four parts as follows: Part I—Rating of Steam and Hot Water Convectors; Part II—Testing of Steam Convectors; Part III—Testing of Hot Water Convectors; and Part IV—Procedure for Obtaining Approval of Ratings. It has been issued for the purpose of receiving constructive suggestions so that adjustments can be made to prepare the code for adoption.

Copies may be obtained by writing to I. J. Fairchild, Chief, Division of Trade Standards, National Bureau of Standards, Washington, D. C.

Committee on Research Annual Report 1944

Report of the Chairman—George L. Tuve

THE EFFORTS of the Research Committee in 1944 were centered upon the technical planning of a program that could be rapidly expanded at the end of the war. There was substantial progress on actual research during the year, but adequate personnel were not yet available either at the Cleveland Laboratory or at the Cooperating Institutions. The research booklet, published in October, gave the Society membership a progress report, and also furnished a basis on which industry could be invited to participate in our enlarged program.

Research work has been in progress during 1944 on at least twenty of the projects outlined in the booklet, and a number of new projects are in the planning stage. Additional cooperative research is under consideration with several universities. Special attention has been paid to the correlation and coordination of our program with similar research elsewhere, and support has been given to the formation of inter-society joint committees in the fields of Psychrometry and of Industrial Ventilation.

During 1943, the Committee on Research, under the Chairmanship of C. M. Ashley, formulated an eight-point program for increasing the scope and magnitude of research operations. Three of these, the securing of a Director of Research, amendment of research regulations and securing a new research home, were accomplished in 1943, and in March 1944 Director Tasker moved the Laboratory to its new location in Cleveland. Three more of the eight objectives were substantially realized in 1944, *viz.*, development of a long-range research program, enlargement of cooperative research with the colleges, and encouragement of participation by industry. The two remaining steps in the program, the expansion of Laboratory staff and the coordination with other technical activities of the Society, were carried as far as circumstances would permit. The research staff now consists of eight full-time members including the Director. One of the outstanding features of the new program has been the great number of day-to-day contacts, both by visit and by correspondence, with Committee members, Society members, and representatives of the engineering profession and of industry. High points in the year's operations are indicated by the statistics in the appended table.

During the Cleveland gas-fire disaster, our Laboratory found an opportunity to render unique service. The *American Gas Association* Testing Laboratories were immediately adjacent to the liquid-gas tanks where the fire originated. Hence, the Testing Laboratory staff escaped only with great difficulty, and their losses were most serious. The space and facilities of a portion of our building were at once offered, and accepted, as a base from which their work of rehabilitation could be directed.

An eminent contribution to the success of our entire research program has been made by Samuel R. Lewis and the Research Finance Committee. Not only was the total of industry participation increased over that of the last several years, but 49 firms increased their subscription over those of the previous year, and 17 other firms participated who had not before had a part in the Society's research program.

The major credit for all features of the 1944 Research Program is due the Society's Director of Research, Cyril Tasker. The Annual Report of the Director, to the Committee on Research, is transmitted as a part of this report.

The response of both members and friends of the Society to the challenge of the enlarged research program has been most gratifying. Many assisted in the preparation of the 1944 Research Booklet. Many others, recipients of the 4000 odd copies of the booklet, have made additional suggestions for technical research. For this encouragement, the Chairman and all members of the Committee on Research are most grateful.

STATISTICS

Meetings:	
Committee on Research	3
Research Executive Committee	6
Research Finance Committee	2
Technical Advisory Committees	27
Chapter Research Presentations	7
Research Projects and Papers:	
Projects under way at Cleveland Laboratory	8
Projects under way at Cooperating Institutions	13
Proposals received for new cooperative projects	7
Research reports and papers received	10

SUMMARY FINANCIAL REPORT
November 1, 1943-October 31, 1944

Income		
From member dues and bank interest		$21,541
Council appropriation		6,598
Industry contributions:		
General (1944)	$5,120	
Earmarked (1944) for future studies	983	
Carried forward from 1943 Earmarked Funds	1,088	
	7,191	
		$35,330
Expenses		
Payments to cooperating Institutions (7)	6,650	
Expenditures at Pittsburgh, at Cleveland Laboratory, and at New York office as per detailed financial report. (See Report of Director of Research)	36,852	
		$43,502

INDUSTRY PARTICIPATION
October 1, 1944 to January 15, 1945

4	Contributions of $1,000.00 or more	$ 4,500
10	Contributions of 500.00 to $1,000.00	5,000
15	Contributions of 200.00 to 500.00	3,400
37	Contributions of 100.00 to 200.00	3,818
21	Contributions below $100.00	790
87		$17,508

Earmarked, $ 6,950.00
General 10,558.00

INSTITUTIONS COOPERATING WITH THE COMMITTEE ON RESEARCH

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
Gravity Circulation of Water in a Vertical Pipe Turbulence Due to Circulating Pumps

CASE SCHOOL OF APPLIED SCIENCE
Air Distribution in Rooms
Heat Transfer Coefficients of *Freon* Refrigerants

CORNELL UNIVERSITY
Methods of Computing Solar Heat Loads of Walls and Roofs
Comparative Analysis of Psychrometric Systems

OREGON STATE COLLEGE
Heat Transfer Through Wetted Walls

UNIVERSITY OF CALIFORNIA
Air and Surface Temperatures in a Panel-Heated Room
The Measurement of the Radiant Effect in Heated and Cooled Rooms
Cooling Tower Design and Performance

UNIVERSITY OF ILLINOIS (COLLEGE OF ENGINEERING)
Heat Losses from Basement Walls and Ceilings
Heat Losses Due to Infiltration

UNIVERSITY OF MINNESOTA
Air Cleaning Devices
Comfort and Environment—Statistical Analysis

UNIVERSITY OF PENNSYLVANIA
The Properties of Air-Water Vapor Mixtures

Report of the Director of Research—Cyril Tasker

The year 1944 has brought to those charged with the carrying out of the Society's research activities problems not wholly independent of the times. In spite of difficulties, we have made progress, perhaps not as great as we would have wished, but we have advanced some distance on the road towards the complete re-organization and re-orientation of Society research.

Viewed in the light of Society history, the high lights of the year will probably be shown as (*a*) the removal of the Research Laboratory from the Bureau of Mines Building in Pittsburgh to its new quarters in Cleveland and (*b*) the preparation and distribution of a research booklet setting forth the details of the first group of projects in the Society's expanded research program. We believe, however, that time will show that in spite of staff shortages, the disturbance due to the removal, and the necessity for rebuilding a going organization, sound research work has been carried on at the Laboratory as well as at many of the cooperating institutions and that the work accomplished will stand in the record after we have forgotten the removal.

For convenience the first part of this report will be divided into a number of main headings dealing with work under the various Technical Advisory Committees of the Society, commencing with a report on their organization and selection.

Technical Advisory Committees

During 1944 there were in existence 21 Technical Advisory Committees. Some have of necessity been more active than others, but it is worthy of mention that, at the 50th Annual Meeting of the Society held in New York in January, 17 of these Committees met to assist in formulating the research program.

Early in the year a careful survey was made of the membership of these Committees and some changes were made in order to bring, into active participation in Society research, men who had shown marked interest and ability for such work. In general an endeavor was made to form Committees with a membership of about 10, but some Committees covered such wide interests that a larger membership was found desirable.

The machinery for handling the work of these Committees was thoroughly overhauled. The Research Laboratory now handles the duplication and distribution of all minutes of Technical Advisory Committee meetings and a duplicate ballot form has been printed to assist in the more speedy handling of papers and reports submitted to the Committees for comment and approval. An attempt has also been made to distribute from time to time to the membership of the Committees technical material which has come into the possession of the Laboratory and which, it was felt, might be of interest in the Committee's activities.

A new Committee was formed in the Spring to deal with *Air Sterilization and Odor Control* and we were fortunate to obtain the consent of Dr. W. F. Wells, University of Pennsylvania Medical School, to act as Chairman.

Air Cleaning—R. S. Dill, *Chairman;* J. J. Burke, C. J. Glanzer, Lt. Col. Theodore Hatch, W. C. L. Hemeon, M. H. Kliefoth, Dr. L. R. Koller, H. E. Lewis, Prof. C. A. McKeeman, J. W. May, H. C. Murphy, G. W. Penney, Prof. E. B. Phelps, Prof. F. B. Rowley, G. H. Schember, J. B. Smith, W. O. Vedder, Maj. R. P. Warren.

The Committee met at the 50th Annual Meeting in New York and again at the Semi-Annual Meeting in Grand Rapids. At the winter meeting a sub-committee was appointed to investigate and report on methods of testing grease filters. The sub-committee submitted its report at the summer meeting, and the Technical Advisory Committee then recommended that this report be studied by the Committee on Research with a view to arranging for the carrying out of additional tests preparatory to the preparation of a code for the testing of grease filters.

The Committee was advised in January that the Air Filter Institute had appointed an Engineering Committee to develop standards and codes for specific air filter applications. A progress report was submitted to the Committee in June and the tentative suggested code is being submitted to the Technical Advisory Committee at the Boston Meeting (January 1945). One meeting of this Committee of the Air Filter Institute was held in September, on the invitation of the Committee on Research, at the Cleveland Laboratory.

The studies under Professor Rowley at the University of Minnesota have continued during 1944, though at a reduced rate due to staff shortages and the priority demands for research for the Armed Services.

Some work has been done on the analysis of different types of filters to obtain the pressure drop through these filters as they become filled with dust and further work has been carried out on the photometric method of rating and testing air filters.

Air Conditioning in Industry—W. L. Fleisher, *Chairman;* L. T. Avery, Comdr. A. R. Behnke, Dr. Leonard Greenburg, W. E. Heibel, D. E. Humphrey, E. F. Hyde, L. L. Lewis, O. W. Ott, Dr. R. R. Sayers, H. E. Ziel.

The Committee met in January at New York and recommended to the Committee on Research that laws, codes, standards and recommendations in heating and ventilating in industrial establishments (not including laws on toxic vapors) be collected and summarized at the Research Laboratory for this Committee to analyze.

Soon after the removal of the Laboratory to Cleveland, a letter was sent out to the various state and municipal authorities requesting them to furnish the Society with copies of all appropriate codes and regulations. The response was very encouraging and to date 167 different codes and standards have been assembled. It is not to be expected that all of these codes contain data pertinent to the study being made, but all will have to be reviewed since in many cases useful information is found where it is least expected.

So far forty-six codes have been reviewed; of these, forty contain definite regulations concerning heating, ventilating or air conditioning, and abstracts of these regulations have been made. This study will be accelerated as staff become available.

Air Distribution and Air Friction—Prof. D. W. Nelson, *Chairman;* C. F. Boester, S. L. Elmer, Jr., W. H. Hoppmann, F. J. Kurth, J. N. Livermore, R. D. Madison, Prof. L. G. Miller, Prof. G. B. Priester, L. P. Saunders, Prof. M. C. Stuart, Ernest Szekely.

Research work under this Committee has had to give way to other work in most of the institutions at which it was being carried out. That it is a very important subject, having wide Society and industrial interest, was shown by the many comments received at the Laboratory on the three projects dealing with air flow which were listed in the Research Booklet.

A meeting of the Committee was held at Grand Rapids and it was recommended that, because of criticisms received by the Society regarding the present Guide chart for "Friction of Air in Pipes," a critical review of all available information, published or otherwise, on this subject be reviewed by a competent engineer working either at the Research Laboratory or elsewhere under the direction of the Committee on Research.

The Committee also agreed on the imperative need for more data on the resistance to the flow of air encountered in the wide variety of duct fittings now in use throughout the industry. The Society has been approached by other organizations interested in this subject with a view to coordinating investigations in the fields covered by this Committee.

Work is now in progress at Case School of Applied Science, under a cooperative agreement with the Society, on air distribution from diffusing grilles, slots and perforated plates.

It has not been possible to date to engage suitable staff to work on these problems at the Laboratory; it is hoped that this condition may soon be remedied for it is apparent that there is a great deal that could be done to obtain more satisfactory data for use by the membership of the Society.

Air Sterilization and Odor Control—Dr. W. F. Wells, *Chairman;* Dr. J. L. Buttolph, Dr. Leonard Greenburg, F. H. Munkelt, G. W. Penney, Prof. J. A. Reyniers, F. W. Robinson, Dr. Mildred Wells, Dr. C.-E. A. Winslow.

This Committee, formed in the spring of 1944, held an informal organization meeting at Grand Rapids and will

meet again at Boston. There is considerable interest in the work of this Committee as evidenced by the papers presented at the Summer Meeting and by the many references in the literature to means for air sterilization and the prevention of the spread of respiratory diseases. The modern tendency to reduce uncontrolled infiltration to a minimum has produced problems in odor control and our research work must assist in finding satisfactory solutions of this problem.

Cooling Load in Summer Air Conditioning—W. E. Zieber, *Chairman;* O. W. Armspach, Frederick Boxall, N. B. Elliott, Lt. Comdr. John Everetts, Jr., W. F. Friend, R. H. Heilman, John James, Prof. C. F. Kayan, C. S. Leopold, Prof. C. O. Mackey, J. H. Walker.

The Committee met both at the 50th Annual Meeting and at the Semi-Annual Meeting. Two papers have been presented to the Society under its sponsorship. They were:

1. Periodic Heat Flow through Homogeneous Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr.
2. Summer Air Conditioning—Summer Weather Data for Lincoln, Nebraska.

They both resulted from cooperative research carried on at Cornell University.

Another paper, closely allied with this Committee's work, entitled "Summer Weather Data for New York City" is also being presented at the 51st Annual Meeting in Boston.

The Committee, having agreed that studies involving mathematical analysis of heat flow through homogeneous walls and roofs could be considered as complete, at least for the time being, has turned its attention to the questions involved in heat transfer through non-homogeneous walls and roofs and the mathematical analysis involved therein. Preliminary calculations have indicated that the position of the insulation (or other material with a low heat-transfer coefficient) would have a material effect upon the time lag and maximum heat flow. At the same time it is desirous of arranging for some practical checks to be made on the calculations, or of obtaining sufficient verification of the factors employed to have the two methods correlated.

The Committee agreed that a wall would have to be built and tested in the sun in order to determine the cycle of Sol-Air temperature and the outside heat transfer coefficients with varying wind velocities over the wall. The data so obtained can then be used in hot-box type tests to check other calculated values.

The Committee is actively interested in projects 15, 16, 17 in the Research Booklet and in cooperation with the Chairman of the Research Committee is presently engaged in making arrangements for cooperative research work to be carried out at other universities as well as continuing the work at Cornell.

Cooling Towers and Spray Ponds—H. B. Nottage, *Chairman;* C. F. Boester, W. W. Cockins, S. C. Coey, E. H. Kendall, E. R. Ketchum, S. R. Lewis, J. F. Park, S. I. Rottmayer, E. W. Simons, E. H. Tate.

Cooperative research work at the University of California has proceeded under the direction of Prof. Boelter and his colleagues. It has not been possible to make a great deal of progress under war-time conditions. However, the subject is of considerable interest, particularly in the western part of the country as was evidenced by several comments received at the Laboratory as a result of the listing of project 19 in the Research Booklet. It is hoped that a Technical Advisory Committee will be appointed during 1945 to deal with another aspect of this same general problem, namely evaporative condensers and spray ponds and that at least one other cooperative project may be arranged in which studies of another aspect of the problem of cooling towers may be made. The Committee has been promised specific assistance to make other studies possible. At its January meeting the Committee recommended that future Society research in this problem should cover among other matters (a) more extensive year-'round weather data and (b) the question of standardization of instruments and methods of testing.

Corrosion—Leo F. Collins, *Chairman;* R. C. Doremus, Dr. E. W. Guernsey, Prof. G. G. Marvin, A. R. Mumford, H. M. Nobis, L. P. Saunders, F. N. Speller, Lt. Comdr. C. M. Sterne.

The Committee met at the time of the 50th Annual Meeting and as a result of suggestions received during 1943 drew up a program of work for 1944. This program in brief consisted of making a thorough search of the technical literature with regard to each of the items set out below, the bibliography so prepared to be supplied to a number of members of the committee, so that they could prepare as complete a treatise on each subject as the available information permitted.

(a) Protective coatings which may be used to minimize corrosion of air conditioning equipment, including ducts handling moist air.
(b) The relation between "bad" water and corrosion in coolers, condensers, and evaporative condensers.
(c) The relationship between internal corrosion of refrigerating systems and those extraneous materials which commonly contaminate refrigerants.
(d) The causes for and the prevention of corrosion in cooling towers, spray humidifiers (and dehumidifiers), cooling coils, and brine spray systems.
(e) The cause and prevention of external corrosion in gas- and oil-fired heaters and connecting flues.
(f) The internal corrosion of steam heating equipment.

The Research Laboratory engaged the services of the Engineering Societies Library to make this literature search and compile the bibliography, and it was distributed in July to six members of the Committee. This step marks a radical change in the main interest of this Technical Advisory Committee, since it had previously confined its attention mostly to the subject of corrosion in steam-heating equipment.

The work which was carried on under this Committee, under a cooperative agreement at the Carnegie Institute of Technology was concluded late in 1943. A paper entitled, Preventing the Solution of CO_2 in Condensates by Venting of the Vapor Space of Steam-Heating Equipment, by D. S. McKinney, J. J. McGovern, C. W. Young, and L. F. Collins will be presented at the Boston Meeting in January 1945. Simultaneously a paper entitled, Studies of the Mechanism of Solution of CO_2 in Condensates formed in the Steam Heating Systems of Buildings, will be presented by the Chairman of the Committee. The general findings of these two papers are:

(1) That venting of the vapor space of steam condensers does not provide a means of producing CO_2-free condensates even when steams containing small concentrations of the gas are used. Notwithstanding, it is possible to produce thereby, from steams *rich* in CO_2, condensates containing gas concentrations of the same order of magnitude (2 to 4 ppm) as ordinarily are formed in equipment using steams of the *lowest* CO_2 content (i.e., about 5 ppm) that are now generated from carbonate-bearing feedwater upon a commercial scale. Theoretically, therefore, venting provides a means of minimizing but not entirely preventing corrosion. Its general use, however, must await the commercial availability of suitable venting devices.
(2) That theory (Henry's and Dalton's Laws) accurately define the factors controlling the CO_2 content of condensates; that the apparent anomalies between theory and field findings have resulted from an imperfect application of the laws. It is shown that the mechanics of condensation, as employed in common types of heating equipment, favor the production of condensates containing a high percentage of the CO_2 entrained with the steam; and that there is a progressive pick-up of CO_2 as the condensate moves down the return system.

Flow of Fluids in Pipes and Fittings—F. E. Giesecke, *Chairman;* T. M. Dugan, Prof. W. S. Harris, S. R. Lewis, L. P. Saunders.

The Committee on Research approved early in 1944 a cooperative research project with the Agricultural and Mechanical College of Texas to study (a) the effect of pipe size on the simultaneous flow of two currents of water of different temperatures in opposite direction in a vertical pipe, and (b) the turbulence produced in the water flowing in a pipe by a jet of a smaller stream projected into the pipe. Only preliminary studies have been possible since the agreement was made, but it is anticipated that a report will be available by the 1945 Summer Meeting.

Fuels—R. A. Sherman, *Chairman;* R. M. Conner, R. S. Dill, R. B. Engdahl, L. N. Hunter, Dr. R. C. Johnson, Prof. S. Konzo, W. M. Myler, Jr., W. T. Reid, Dr. H. J. Rose, C. E. Shaffer, T. H. Smoot, R. K. Thulman, Capt. T. H. Urdahl, E. C. Webb.

The Committee met in January and studied the comments received from the members on a ballot of proposed projects that had been distributed for Committee study and voting. The Chairman pointed out that the returns had revealed

that the predominant desire was for a fundamental and comprehensive investigation of factors covering:

1. The performance of chimneys.
2. The performance of barometric dampers.
3. The methods for measuring flue gas and surface temperatures.

As it was found impossible to make a study of chimneys at the Cleveland Laboratory, at least at the moment, the Laboratory undertook a study of the performance of barometric dampers. Invitations were sent from the Laboratory to all known manufacturers to submit one or more of their products for study. Eight different manufacturers responded, and some 14 different dampers were received. Preliminary tests were all made with the dampers connected to a horizontal duct system in which the draft was supplied by means of a fan. The dampers were then installed in the flue pipe connecting a gas-fired furnace with a chimney built entirely within the Laboratory Building, so that the effect of the barometric damper could be studied when hot gases were flowing through the flue pipe. A progress report is being made to the Committee at the Boston Meeting.

At the recommendation of this Committee a paper, prepared by R. S. Dill, dealing with testing methods and rating limits for domestic heating devices, is being presented at the 51st Annual Meeting.

Glass—R. A. Miller, *Chairman:* L. T. Avery, H. C. Dickinson, J. D. Edwards, J. E. Frazier, E. H. Hobbie, Dr. J. C. Hostetter, Prof. Axel Marin, W. C. Randall, Prof. L. E. Seeley, J. P. Staples, H. B. Vincent, G. B. Watkins, F. C. Weinert.

The Committee met in January 1944 and after considerable discussion requested that the Research Laboratory "prepare a bibliography of data on heat transmission through windows and through glass-block panels, abstract these data, tabulate the results given and present the abstracts and tabulations to the Committee together with comments on methods and reliability of results. The bibliography collected should include all available data on film coefficients for single and multiple glazing and heat loss or gain from shaded glass areas. Data on solar radiation relating to the above topics should be included. Data on summer and winter requirements should be segregated."

Early in the summer the Laboratory secured the services of Prof. G. V. Parmelee, Fenn College, Cleveland, to work on this project, having first requested the Engineering Societies Library to make a literature search and prepare a bibliography. It is interesting to note that using this bibliography as a basis, Professor Parmelee was able to add, to the references supplied, an almost equal number.

A very comprehensive report has been prepared and is being submitted to an editorial sub-committee for review and criticism, so that the material can be published as a special research bulletin of the Committee on Research. A summary report has also been prepared and distributed to the Committee membership. Suggestions have been made as to future research work which should be carried out to clarify the points on which present data appear to be inadequate or lacking. The Laboratory staff gratefully acknowledge the wholehearted cooperation of the members of this Committee and of many others in the glass industry in the preparation of this report.

Heat Requirements of Buildings—P. D. Close, *Chairman;* C. M. Ashley, E. K. Campbell, J. F. Collins, Jr., Dr. F. E. Giesecke, H. H. Mather, M. W. McRae, Prof. C. H. Pesterfield, Prof. T. F. Rockwell, Prof. F. B. Rowley, R. K. Thulman.

The Committee met in January, 1944, in New York and, after considerable discussion on the question of exposure factors, went on record *as being opposed in general to the use of exposure factors as such,* adding a recommendation *that the problem be considered under the heading of infiltration, since wind generally has only a relatively minor effect on the transmission losses, excepting in the case of glass transmission losses or heat losses through thin, highly conducive materials.*

The Committee agreed that there was an urgent need for more accurate infiltration data on actual buildings under operating conditions and discussed, in some detail, methods of measuring infiltration. At a meeting held in Grand Rapids in June, the Committee agreed on three proposed methods as follows:

(1) A plenum chamber pressure difference method using simple equipment suggested by C. M. Ashley.

(2) By measuring the rate of decay of concentration of CO_2 released into a room.

(3) By measuring the total heat input and subtracting the calculated transmission loss.

Studies are presently under way in Pittsburgh at the residence of Prof. T. F. Rockwell and at the IBR Research Home in Urbana, Illinois, in cooperation with the University of Illinois.

This problem has great Society interest and though staff shortages at several institutions have made it impossible to carry studies through at the rate desired, this problem is well to the fore in our future work.

Funds earmarked for this study were provided by the *Insulation Board Institute* during 1944.

Heat Transfer of Finned Tubes—William Goodman, *Chairman;* C. L. Benson, W. E. Heibel, J. W. McElgin, R. H. Norris, L. P. Saunders, L. G. Seigel, W. C. Whittlesey.

The Committee has undertaken a study of refrigerant-side film coefficients and their effect upon the over-all performance of direct-expansion air coolers. A cooperative experimental program is being carried on at Case School of Applied Science. A test unit has been set up which allows the refrigerant coefficients in various parts of an evaporator to be measured. Effects of load and of the oil content of the refrigerant are being studied, as are also the effects of flash gas, of quality and of superheat.

The Committee reviewed and accepted for presentation at the 1945 Annual Meeting a paper by L. G. Seigel on Air Cooling Coil Problems and Their Solutions. This paper is the result of a research program undertaken at the instigation of the Navy Department, Bureau of Ships, Air Conditioning Section, and carried on at Case School of Applied Science. The paper discusses the general application of the *Humidity Method* (presented by the author before the Society in 1938. Trans. Vol. 44, 1938, p. 523), extending its use for direct-expansion coils.

Instruments—C. M. Ashley, *Chairman;* Prof. L. M. Boelter, E. L. Broderick, R. S. Dill, R. B. Engdahl, Lt. Col. A. P. Gagge, Dean John A. Goff, Prof. C. M. Humphreys, Prof. R. C. Jordan, R. D. Madison, Prof. D. W. Nelson, W. R. Teller.

The Technical Advisory Committee on Instruments met at New York in January in a combined meeting with the Committee on Radiation and Comfort. Most of the discussion at this meeting centered around the measurement of radiation and comfort effects since it was felt that the development of a suitable instrument or instruments capable of measuring mean radiant temperature, or some other factor which can be correlated with comfort effect in radiant heating, was of the highest importance in future studies. The Committee was very much interested in comments made by Professor Edy Velander of Sweden who told of similar work being undertaken in Swedish research organizations.

In order to summarize the present position, a sub-committee was appointed to prepare a bibliography on methods and instruments available for measuring radiation temperatures under comfort conditions. The sub-committee, which consisted of Messrs. Broderick, Humphreys, and F. W. Hutchinson, with Professor Fahnestock as chairman, prepared a bibliography which was later duplicated and distributed to members of the Committee. It contained 26 references, and was entitled, The Measurement of Effective Temperature and Mean Radiant Temperature in Rooms for Human Occupancy. Copies will be made available to any other interested parties on request.

An informal meeting of the Committee was held at Grand Rapids in June, and as a result the Chairman prepared a comprehensive list covering instruments in practically all the fields that may be of interest to members of the Society. It is the intention of this Committee to analyze the instrument question very thoroughly, and set up a program of experimental work on those instruments on which it is felt work is needed in the immediate future. This comprehensive list has been distributed to all members of the Com-

mittee and will be discussed at their meeting at Boston in January 1945.

Insulation—E. R. Queer, *Chairman;* R. E. Backstrom, C. F. Boester, T. H. Coulter, J. D. Edwards, Prof. F. G. Hechler, H. E. Lewis, Prof. C. E. Lund, H. E. Robinson, T. D. Stafford, Prof. G. B. Wilkes, P. M. Woodworth.

The activities of this Committee were limited during 1944 to a revision of Chapter 4 of THE GUIDE—Heat Transmission Coefficients. The test work to determine new thermal conductivity values for THE GUIDE, which are much in demand, has been held in abeyance until a later date when more facilities can be made available.

Physiological Reactions—Dr. R. W. Keeton, *Chairman;* Dr. Thomas Bedford, Comdr. A. R. Behnke, Dr. A. C. Burton, Dr. E. F. DuBois, Lt. Col. A. P. Gagge, Comdr. F. C. Houghten, Dr. A. C. Ivy, Dr. R. R. Sayers, Dr. Charles Sheard, Col. A. D. Tuttle, Dr. C.-E. A. Winslow.

The Committee's chief purpose is to present, at various intervals, summaries of current physiological researches with special relation to their bearing on engineering practice.

As soon as the Armed Services are in a position to release, for the benefit of the engineering profession, the results of the many physiological studies they have made during the past three or four years, this Committee intends to interpret the data for the benefit of the Society membership.

The active research program at the University of Illinois Medical School cannot yet be resumed due to the priority demands of war activities.

Psychrometry—J. H. Walker, *Chairman;* W. H. Carrier, Dr. H. C. Dickinson, Dean John A. Goff, Prof. William Goodman, Prof. A. P. Kratz, Dr. D. M. Little, Prof. C. O. Mackey, W. E. K. Middleton.

The Committee met in January 1944, in New York and again at Grand Rapids in June. The results of the cooperative research work which has been under way at the University of Pennsylvania for some time were summarized late in the year in the form of a paper, by John A. Goff and S. Gratch, entitled, Thermodynamic Properties of Moist Air. This paper is being presented at the 51st Annual Meeting in Boston and the data will then be available for use in a proposed revision of Table 6, Chapter I of THE GUIDE.

The ultimate objective of this cooperative investigation has been a formulation of the thermodynamic properties of moist air which, by reason of accuracy and thermodynamic consistency, can claim universal acceptance as standard.

At the January meeting, the Committee considered a suggested program of work in hygrometry submitted by Messrs. Harrison and Little of the U. S. Weather Bureau and the Committee went on record as recognizing that, following completion of current thermodynamic studies, attention should be directed to the development of suitable instruments for measuring moisture content in air, such instruments to have an accuracy comparable with the new thermodynamic data. The Committee also felt that attention should be directed to the development of a suitable technique for calibrating existing and new instruments or apparatus for measuring moisture content.

To this end, the Laboratory prepared, late in the year, a report on "The Accuracy of Psychrometric Instruments and Their Application," to assist the Committee to plan a program of experimental work. Copies of this report may be obtained from the Laboratory on request.

Inter Society Committee

The Committee, at its meeting in June, recommended to the Council that invitations be sent to all organizations likely to be interested in the problem of the properties of mixtures of air and water vapor to appoint a representative on a joint inter-society committee to consider the adoption, when available, of basic equations and tables of such properties.

The Council approved this recommendation and invitations were, therefore, sent out in the name of the Society by Pres. S. H. Downs to the following organizations:

United States	American Society of Mechanical Engineers. American Society of Refrigerating Engineers American Institute of Chemical Engineers American Physical Society Institute of Aeronautical Sciences, Inc. Department of Commerce National Bureau of Standards Weather Bureau
Canada	Meteorological Div., Canadian Dept. of Transport National Research Council of Canada
Great Britain	Institution of Heating and Ventilating Engineers Physical Society of London National Physical Laboratory

The inaugural meeting was held at Boston on January 23, 1945.

Radiation and Comfort—J. C. Fitts, *Chairman;* R. E. Daly, Dr. F. E. Giesecke, L. N. Hunter, Prof. F. W. Hutchinson, John James, Prof. A. P. Kratz, C. S. Leopold, E. M. Mittendorff, L. L. Munier, Prof. D. W. Nelson, G. W. Penney, W. R. Rhoton.

The Committee met in January 1944, in a joint session with the Technical Advisory Committee on Instruments, the main feature of which was the discussion of methods of measuring radiation and comfort effects. It was generally agreed that this problem is fundamental to all studies of radiant heating and cooling and that no instruments presently available can be considered as wholly satisfactory for use in laboratory or field studies.

As a result of cooperative research under way at the University of California under the sponsorship of this Committee, a paper entitled, Radiation Corrections for Basic Constants used in the Design of all Types of Heating Systems, is being presented at the 51st Annual Meeting by B. F. Raber and F. W. Hutchinson.

The first part of the paper presents a rational procedure for determining the design inside air temperature for an enclosure heated by any conventional system of the convective type while the later sections are devoted to an examination of the inside and outside combined surface heat transfer coefficients for convection and for radiation.

The comments received at the Laboratory with respect to the three projects, listed in the Research Booklet, which deal with radiant heating have emphasized the great interest being taken in this subject by many members of the Society and by certain sections of the industry.

Sensations of Comfort—Thomas Chester, *Chairman;* G. D. Fife, E. P. Heckel, N. A. Hollister, Lt. Col. W. J. McConnell, F. C. McIntosh, A. B. Newton, Prof. B. F. Raber, K. E. Robinson, H. A. Thornburg, Prof. C. P. Yaglou.

The re-study and analysis of data taken in 1937 during a cooperative research project between the Minneapolis-Honeywell Regulator Company and the Society has been continued at the University of Minnesota as a cooperative project. They report as follows:

"Data from the 25,000 cards which were originally taken have been tabulated on special tabulating machine cards. The sorting and analyzing of these data is now in progress and the work is about 50 per cent complete.

"The first part of the analysis consists of a study of the effects of dry bulb temperature and relative humidity on the sensation of comfort. From data obtained in the investigations, combinations of dry-bulb temperature and relative humidity giving equal effective temperatures are collected and curves have been plotted showing sensations of comfort as ordinates and dry-bulb temperatures as abscissae. The variations in the sensation of comfort as recorded by the test subjects are now being analyzed to find the cause of these variations. Some interesting trends are apparent. However, in many cases, even though there were 25,000 cards, sufficient fundamental data are not available to draw definite conclusions. It has been difficult for the University to maintain an adequate research staff on this program, but it is expected that the work will be completed within the next two or three months. The final analyses of the test data have involved a considerable amount of study and numerous graphs are being drawn in an effort to get the true significance of the records which were taken."

From the preliminary results it seems highly likely that further research work will be recommended with concentration on some of the more vital factors involved.

The Committee met in New York in January jointly with the Technical Advisory Committee on Physiological Reactions and recommended that, as soon as conditions permitted, studies be undertaken on the effect of low dew

points on comfort and health and on the physiological and psychological effects of drafts.

Sorbents—Lt. Comdr. John Everetts, Jr., *Chairman;* R. E. Cherne, O. D. Colvin, F. C. Dehler, Ralph Fehr, Dean John A. Goff, W. R. Hainsworth, C. H. B. Hotchkiss, J. C. Patterson, G. L. Simpson.

The Committee, formed in 1943, met at the time of the 50th Annual Meeting in New York and adopted the following program for immediate action:

(1) A review of THE GUIDE Chapter on cooling, dehumidification and dehydration.
(2) A determination of the types of industries, processes and applications to which sorbents may be practically and economically applied.
(3) A determination of inter-action constants for other pressures than atmosphere.
(4) Correlation of chemical and physical characteristics of commercially available sorbents.
(5) Compilation of data on storage requirements of materials of all kinds which are affected by changes of humidity.

Under Item (1), recommendations have been made to the Guide Publication Committee to revise and clarify the definitions of "Dehumidification" and "Dehydration" in accordance with present practice and usage of these terms. Revised definitions have been submitted for consideration and approval. No other changes in THE GUIDE have been recommended at this time pending a study and correlation of available data on Sorbents.

Under Item (4), considerable data have been accumulated during the past year on the following Sorbents:

a. Silica Gel, *b.* Activated Alumina, *c.* Dow Chemical Co. 8A Solution, *d.* Dow Chemical Co. 17A Solution, *e.* Lithium Chloride, *f.* Calcium Chloride, *g.* Glycols and Glycol derivatives.

Correlation of these data will be made as soon as more complete information becomes available.

Preliminary work has been commenced on the other three items listed above, but progress has been delayed primarily because of the manpower shortage.

Sound Control—R. D. Madison, *Chairman;* C. M. Ashley, Dr. P. H. Geiger, W. W. Kennedy, G. C. Kerr, A. G. Sutcliffe, Capt. T. H. Urdahl, Dr. T. A. Walters.

Two Committee meetings were held during 1944 and a full program developed. Unfortunately, it has not been found possible to resume during the year the studies commenced in 1940 at the Rensselaer Polytechnic Institute under a cooperative agreement with the Society. Staff with training in this type of work are in great demand by the Armed Services and any servicing of sound measureing equipment entails long delay.

The Committee has agreed to proceed with studies dealing with:

(1) Apparatus measurement, ultimately leading to sound test codes.
(2) Attenuation of ducts, elbows and other fittings.
(3) Room conditions and recommended sound levels.

The Committee has gone on record as being dissatisfied with the relatively broad tolerances with regard to sound level meters permitted under present standards, since these tolerances cause great difficulties in the practical use of such meters.

As a preliminary to an intensive program of sound energy studies at the Cleveland Laboratory, some tests were made of fans fitted with inlet and outlet ducts, measurements being made of the total sound generated and its effect on the room sound level.

Difficulties with the Laboratory's sound level equipment caused these tests to be postponed pending a check and recalibration by an outside agency.

The cooperation of the Insulation Board Institute in generously providing a supply of rigid insulation for the construction of a test room is gratefully acknowledged by the Technical Advisory Committee and the Committee on Research.

Weather Design Conditions—Capt. T. H. Urdahl, *Chairman;* J. C. Albright, C. E. Bentley, R. E. Biller, H. S. Birkett, P. D. Close, J. F. Collins, Jr., Lt. Comdr. John Everetts, Jr., J. P. Fitzsimons, Prof. C. M. Humphreys, Capt. J. D. Kroeker, Comdr. F. W. Reichelderfer.

The Committee met at New York at the time of the 50th Annual Meeting and agreed that it was illogical to try to determine design temperatures based simply on extreme temperatures on record or on means of extremes for any particular month.

Since extensive data for 110 stations throughout the country could be made available to the Society through the U. S. Weather Bureau, the Committee on Research approved the recommendation of the Technical Advisory Committee that arrangements be made to have this data analyzed either at the Research Laboratory or elsewhere if more suitable arrangements could be made.

To govern the method of analysis, the following recommendations were made:

(1) The design dry-bulb temperature for winter shall be taken as that temperature which is equalled or exceeded for 97½ per cent of the hours during the months of December, January, February and March. The winter wet-bulb temperature and dew-point shall be taken as those temperatures which are equalled or exceeded for 95 per cent of the hours during the same months.

(2) The summer design dry-bulb temperature shall be taken as that temperature which is equalled or exceeded by no more than 2½ per cent of the hours during June, July, August and September. The design wet-bulb and dew-point temperatures for these same months shall be those temperatures which are not exceeded for more than 5 per cent of the time.
(3) Wind data shall be prepared in tabulated form.

During the spring and early summer, one member of the Committee, J. C. Albright, personally condensed about half of the data for one station so as to devise satisfactory speed-up techniques and methods of presenting the data. At a later date, the suggestion was made that the collected data be analyzed at the Statistical Laboratory of Iowa State College. Negotiations are now in progress with a view to setting up a cooperative research project for this purpose. The final method of presentation of the data will be decided by the Technical Advisory Committee, since it is most essential that the data be presented in a form readily usable by air conditioning engineers.

Oregon Chapter Research Advisory Committee—J. E. Yates, *Chairman.*

The cooperative project on a study of *the heat flow through wet building walls* being carried out at Oregon State College is proceeding as rapidly as the man-power situation permits. One of the most serious difficulties during the tests has been the warping of the test wall sections when subjected to conditions simulating heavy rain. Recent improvements in the test equipment have allowed some tests to be run on the walls and the results check published data for dry still air and 15 mph wind satisfactorily.

Other Laboratory Activities

In addition to the work conducted at the Laboratory under the direction of the various Technical Advisory Committees, other Laboratory activities are discussed below.

Staff

The Laboratory was fortunate in obtaining the temporary services of Prof. Clark M. Humphreys who acted as Senior Engineer from May 15 to October 6, when he returned to other duties at Pittsburgh. His assistance in the difficult first months at the new Laboratory is gratefully acknowledged.

At present the Laboratory staff is made up as follows: G. V. Parmelee (on leave of absence from Fenn College, Cleveland), Research Fellow; R. G. Huebscher, Research Assistant; Doris M. Dietz, Laboratory Assistant; William L. Ryan, Mechanic; Ilse M. Jahn, Office Manager and Secretary; Lelia D. Henderson and Thelma T. Branske, Stenographers.

During the past few months we have continuously been on the lookout for additional trained technical staff. This is the most pressing problem facing the Laboratory today and one in which the assistance of all members of the Committee and friends of the Society is requested.

CONDENSED FINANCIAL REPORT
RESEARCH FUND
Oct. 31, 1944

Assets		
Cash on hand and on deposit		$27,650.02
Laboratory equipment, furniture and fixtures		6,359.53
Prepaid rent		1,325.00
TOTAL RESEARCH FUND		$35,334.55
Endowment Fund		588.06
		$35,922.61
Liabilities and Funds		
Accounts payable and taxes		$ 1,417.86
Unexpended balance of Council appropriation		3,401.95
Deferred income—earmarked projects		2,842.70
Prepaid dues for 1945		290.06
Research Fund		27,381.98
TOTAL RESEARCH LIABILITIES AND FUND..		$35,334.55
Endowment Fund		588.06
		$35,922.61

ANALYSIS OF RESEARCH FUND

Balance November 1, 1943			$28,749.54
Additions			
Refund—University of Wisconsin	$1,185.85		
Equipment, furniture and fixtures	6,601.27	$7,787.12	
Deductions			
Excess of expenses over income for fiscal year ended Oct. 31, 1944		9,154.68	
NET REDUCTION			1,367.56
Balance Oct. 31, 1944 per balance sheet			$27,381.98

STATEMENT OF INCOME AND EXPENSES
FOR THE FISCAL YEAR ENDED OCTOBER 31, 1944

INCOME			
From A.S.H.V.E.			
40% of 1944 and prior years dues collected		$21,503.60	
Special Council appropriation		6,598.05	$28,101.65
Contributions—Per Schedule			
General		$ 4,803.00	
Earmarked		316.75	
Glass Study—balance from prior year		1,088.38	6,208.13
Interest from Bank Deposits			37.63
TOTAL INCOME			$34,347.41
EXPENSES			
Chairman and Committee			
Traveling	$ 673.07		
Chairman's Office	102.31		
Professional Services	200.00	975.38	
Research Laboratory			
Salaries—Administrative and Technical	$16,101.83		
Salaries—Clerical (N. Y. and Laboratory)	3,901.32		
Traveling	1,385.87		
Postage	283.82		
Telephone and Telegraph	308.56		
Office Expenses and Supplies	746.13		
Printing and Mimeographing	950.00		
Library and Periodicals	217.30		
Laboratory Materials and Supplies	1,504.61		
Insurance	231.01		
Depreciation—Equipment and Fixtures	340.71		
Unallocated	133.10		
Taxes (Cleveland rent)	1,855.00		
Property Insurance	288.55		
Heating	385.00		
Electricity	86.50		
Gas	12.96		
Water	13.50		
Janitor	516.40		
Building Maintenance	16.48	29,278.66	
Cooperative Research			
University of California	$ 1,600.00		
University of Minnesota	1,200.00		
Case School of Applied Science	2,000.00		
Oregon State College	500.00		
Texas A & M College	250.00		
Cornell University	500.00		
University of Pennsylvania	600.00	6,650.00	
Special Council Appropriation			
Expended part of $10,000.00 Grant		6,598.05	43,502.09
EXCESS OF EXPENSES OVER INCOME			$ 9,154.68

Research Booklet

The research booklet, published in October and distributed, firstly to some 400 executives of the industry in connection with the financial appeal, and later in the month to the entire membership of the Society, has attracted considerable attention not only in the Society but outside of it also. We have had a large number of requests for booklets and though 4250 copies were printed, it is now out of print and only a few file and reference copies remain.

It entailed a great deal of effort by the members of the Research Executive Committee and the Chairmen of the various Technical Advisory Committees as well as by the Laboratory staff. The assistance given by the Secretary of the Society, A. V. Hutchinson, merits especial mention—much of the attractiveness of the make-up of the booklet resulted from his suggestions.

We have received, as a result of this booklet, a number of helpful letters suggesting other research projects of importance to the profession and industry. We venture to believe that the booklet was of great assistance in the financial campaign in that it set out a planned research program for industry inspection and study.

The expenses incurred in the printing and distribution of the booklet were charged jointly against the general research funds and the special Council appropriation.

Navy Reports

Late in the summer, the Research Laboratory was advised that the Bureau of Ships was anxious to obtain several additional copies of the reports made to the Navy Dept. by the Society under contracts numbered 66853 and NYs 10817. After discussion with Capt. Stacey and Comdr. Urdahl, it was decided that the reports should be retyped in such a way that they could be reproduced by photolithography.

They were, at the same time, carefully edited and rearranged so that composite reports could be prepared; this entailed considerable work by the Laboratory staff, but resulted in well arranged and concise reports. The Navy Dept. set up a new contract to cover the printing of these reports. The release of the information given therein, for the benefit of the Society membership, has been agreed upon by the Navy Dept.

The reports will be bound in 4 books as follows:

BOOK I	Cyclic Temperature Changes in a Ship Structure Due to Sun Radiation The Humidification of Living Quarters on Naval Ships Air Volume Requirements for Occupants of Space on Naval Ships Cooling Requirements of Aviator Ready Rooms on Aircraft Carriers The Spot Cooling of Workers in Engine and Fire Rooms of Naval Ships
BOOK II	Noise Measurement and the Physiological and Psychological Effects of Noise on Man
BOOK III	Effect of Branch Take-Off Design on Noise in Ventilating Duct Systems A Psychological and Physiological Study of the Accuracy, Variability, and Volume of Work of Young Men in Hot Spaces with Different Noise Levels
BOOK IV	Physiological Response of Subjects Exposed to High Effective Temperatures and Elevated Mean Radiant Temperatures

Cooperative Agreements

In view of the plan to enlarge the cooperative research activities of the Society, the Laboratory was instructed to make a study of all past and existing cooperative contracts with a view to recommending a skeleton contract that might be generally applicable for future agreements.

The results of the study were transmitted to the subcommittee, consisting of Prof. L. E. Seeley (*Chairman*), W. E. Heibel and Dr. C.-E. A. Winslow, appointed at the June meeting of the Committee on Research *to investigate the form of the cooperative contract to be drawn up between the Society and institutions with which we desire to carry out cooperative research work.* This Committee

will report at the final meeting of the 1944 Committee on Research.

Equipment

Prior to the removal of the Laboratory from Pittsburgh, all office and Laboratory equipment was carefully examined; only those items for which a definite use could be foreseen were removed to Cleveland and most of this equipment has since been overhauled, repaired and put back into service.

New equipment has been purchased or fabricated as the need arose and all equipment entered on the inventory records. Old equipment was evaluated in the light of present conditions; a complete inventory was prepared and a depreciation reserve established.

Design of Psychrometric Rooms

Several of the Technical Advisory Committees have recommended the construction of new psychrometric rooms at the Cleveland Laboratory to enable studies on panel heating, comfort and environment, heat transmission and air distribution to be made. Space on the main floor at the Cleveland Laboratory would allow us to build two interconnected rooms each with interior dimensions of 12 ft x 18 ft. Ample headroom is available; steam generating equipment and refrigeration equipment would be located in the basement, fans would be located on the main floor.

Plans have been prepared showing the projected location of these rooms; some detailed drawings have been made of suggested methods of construction.

One proposal is to build a double walled room, with the outer wall heavily insulated and the inner wall arranged for easy dismantling to make changes to suit any required condition without disturbing the main structure. Arrangements would be provided for varying the ceiling height, if necessary, for installing heating or cooling panels, and for cooling the interior walls by circulating chilled air through some or all the stud spaces. Adequate crawl space would be provided between the floor of the room and the Laboratory floor and arrangements made for taking visual observations from outside the room of the activities of subjects in the room. All instruments that could be read from outside the room would be so installed as to allow this.

In connection with the design of these rooms, Professor Humphreys visited during the summer the following laboratories having psychrometric rooms and discussed methods of construction and operation with the operating personnel:

Aero Medical Research Laboratory, Wright Field, Dayton, O.
Armoured Medical Research Laboratory, Fort Knox, Ky.
Naval Medical Research Institute, Bethesda, Md.
U. S. Institute of Public Health, Bethesda, Md.
Navy Air Experiment Station, U. S. Navy Yard, Philadelphia, Pa.
Pierce Laboratory, New Haven, Conn.
Climatic Research Laboratory, Lawrence, Mass.
Harvard Fatigue Laboratory, Boston, Mass.

Library

At the June meeting of the Committee on Research, approval was given for the establishment at the Laboratory of an adequate library to be named *The John R. Allen Memorial Library*. A suitable bookplate is now being prepared and a general invitation will be sent to authors of text books in the field of heating, ventilating and air conditioning to donate a copy of their book or books to this library. A general invitation will be made to all members of the Society to contribute books, pamphlets and reprints to this library. All donations will be shown on the bookplate and reported in the Journal.

CONTRIBUTORS TO RESEARCH
1944 Program

Financial Contributions

Aerofin Corp.
*Airtemp Division of Chrysler Corp.
Alco Valve Co., Inc.
Allegheny County Steam Heating Co.
Aluminum Company of America
American Blower Corp.
American Rolling Mill Co., The
*Anemostat Corporation of America
A.S.H.V.E.—Illinois Chapter
Barber-Colman Co.
Barnes & Jones, Inc.
Bayley Blower Co.
Bethlehem Steel Co.
Brunner Manufacturing Co.
Buffalo Forge Co.
Burnham Boiler Corp.
*Byers Co., A. M.
Carrier Corp.
*Chamberlin Metal Weatherstrip Co.
Chase Brass & Copper Co.
Chicago Pump Co.
*Conkey, H. D., & Co., Field Control Division
Crane Co.
*Detroit Edison Co., The
Dole Valve Co.
Dravo Corp.
Driscoll, W. H.
Duquesne Light Co.
Forslund Pump & Machinery Co.
Frick Co., Inc.
Fulton Sylphon Co.
G & O Manufacturing Co.
Hays Corp.
Heating, Piping & Air Conditioning Contractors National Association
Hoffman Specialty Co., Inc.
Ilg Electric Ventilating Co.
Illinois Engineering Co.
Illinois Testing Laboratories, Inc.
*Insulation Board Institute
Johns-Manville
*Johnson Service Co.
Keeney Publishing Co.
Kewanee Boiler Corp.
Kinetic Chemicals, Inc.
*La-Del Conveyor & Mfg. Co.
Mahon Co., R. C., The
*May Oil Burner Corp.
McDonnell & Miller
McQuay, Inc.
Mellish & Murray Co.
Minneapolis-Honeywell Regulator Co.
*Modine Manufacturing Co.
Mueller Brass Co.
*Narowetz Heating & Ventilating Co.
Nash Engineering Co., The
National Radiator Co., The
National Tube Co.
*Nesbitt, John J., Inc.
*Owens-Corning Fiberglas Corp.
*Perfex Corp., The
Pipe Fabrication Institute
Pittsburgh Corning Corp.
*Pittsburgh Plate Glass Co.
Portland Cement Association
Powers Regulator Co.
Pyle-National Co., The
Raisler Corp.
Randall Graphite Products Corp.
*Russell, F. C., Co., The
*Sarcotherm Controls, Inc.
Servel, Inc.
Sisalkraft Co., The
Spencer Thermostat Co.
Sturtevant, B. F., Co.
Surface Combustion
Taylor Instrument Cos.
Tempil Corp.
*Thrush, H. A., & Co.
Timken Detroit Axle Co.
*Trade Wind Motorfans, Inc.
Trane Co., The
*U. S. Machine Corp.
Weil-McLain Co.
Williams Oil-O-Matic Heating Corp.
Wing, L. J., Mfg. Co.
Wood Conversion Co.
*Worthington Pump & Machinery Corp.
York Corp.
Young Radiator Co.

Contributors of Equipment, etc.

American Blower Corp.
Detroit Edison Co., The
Insulation Board Institute
Minneapolis-Honeywell Regulator Co.
Modine Manufacturing Co.
Rhoton, W. R., Co., The

*Earmarked Contributions.

RESEARCH PAPERS—1944

1. Some Effects of Attic Fan Operation on Comfort, by W. A. Hinton, and W. G. Wanamaker (Atlanta) (May 1944, Journal).
2. Periodic Heat Flow—Homogeneous Walls or Roofs, by C. O. Mackey and L. T. Wright (Ithaca) (September 1944, Journal).
3. Radiation Corrections for Basic Constants Used in the Design of All Types of Heating Systems, by B. F. Raber and F. W. Hutchinson (California) (December 1944, Journal).
4. Preventing the Solution of CO_2 in Condensates by Venting of the Vapor Space of Steam Heating Equipment, by D. S. McKinney, J. J. McGovern, C. W. Young and L. F. Collins (Pittsburgh) (February 1945, Journal).
5. Thermodynamic Properties of Moist Air, by John A. Goff and S. Gratch (Pennsylvania) (to be published later).
6. Summer Weather Data and Sol-Air Temperature: Study of Data for Lincoln, Nebraska, by C. O. Mackey (Ithaca) (January 1945, Journal).
7. Air Cooling Coil Problems and Their Solutions, by L. G. Seigel (Case School) (February 1945, Journal).

Conference on Industrial Ventilation

A GROUP of about 30 Society members and others interested in problems in industrial hygiene and ventilation met in the Horace H. Rackham Educational Memorial, Detroit, on March 13 to consider how best the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS might assist in providing more adequate technical information on these questions for Society members and for industrial hygiene engineers generally.

Prof. G. L. Tuve, Cleveland, Chairman, Committee on Research, acted as Chairman of the meeting and among those present were:

L. T. Avery, Cleveland; Maj. A. D. Brandt, Chicago; J. W. Brennan, Detroit; J. J. Burke, Wilmington; Lt. Caplin, Lansing; Thomas Chester, Detroit; R. F. Connell, Detroit; O. E. Fenn, Detroit; W. L. Fleisher, New York; Don Hanna, Columbus; A. H. Kirkpatrick, Detroit; L. L. Lewis, Syracuse; Lt. Benjamin Linsky, Detroit; T. H. Mabley, Detroit; F. E. Macauley, Lansing; W. H. Old, Detroit; F. A. Patty, Detroit; G. W. Penney, Pittsburgh; Prof. C. H. Pesterfield, Lansing; W. C. Randall, Detroit; W. J. Rettenmier, Detroit; K. E. Robinson, Lansing; Dr. Clarence Selby, Detroit; Mr. Soet, Lansing; F. A. VanAtta, Chicago; Maj. R. P. Warren, Baltimore; G. D. Winans, Detroit; W. N. Witheridge, Detroit; H. E. Ziel, Detroit; Clifford Strock, New York; A. V. Hutchinson, Secretary of the Society; and Cyril Tasker, Director of Research.

In opening the meeting, Professor Tuve stated that a number of papers dealing with problems in industrial hygiene and industrial ventilation, recently presented before the Society, had pointed out the need for closer cooperation between the Society and industrial hygiene engineers. It had been suggested that a Joint Inter-Society Committee on Industrial Ventilation Problems be called at the time of the 51st Annual Meeting in Boston, January 1945, but it had been found impossible to complete the organization of such a Committee at that time; this conference might be considered as a preliminary step in the formation of such a committee. The field to be covered should be that of industrial ventilation; *i.e.*, the improvement of conditions considered to be injurious to health.

Letters were read from Dr. Leonard Greenburg (New York State Department of Labor) and J. R. Allan, Chairman, Industrial Hygiene Codes Committee, *American Foundrymen's Association.*

A number of speakers pointed out that in studying industrial ventilation systems installed in plants around the country, peculiar and difficult conditions had been encountered because those responsible had separated the problem into two parts, supply and exhaust. Elaborate exhaust systems had been installed without due consideration being given to the necessity for supply air to balance the amount exhausted. Other speakers stressed the point that industrial hygiene engineers have, of necessity, to give very careful attention to the removal, not only of dust, but also of many other contaminants such as toxic fumes, mists and vapors. The industrial hygiene engineer is primarily concerned with the control of toxic substances in the air; either confining them, or diluting them until they are no longer harmful. In general, therefore, it was said, the problem becomes: (1) Where do these toxic conditions exist? (2) By what mechanism are they generated? (3) How can they be removed or diluted until they are no longer harmful?

Other speakers pointed out the wide variety of problems encountered in industrial ventilation practice. It was possible, for instance, to effectively hood each piece of equipment in an area where heat treating or quenching was being carried on and, by this means, very nominal rates of air change could be used. Such treatment is, however, either impossible or extremely difficult where large quantities of materials are being moved by means of conveyors or other types of handling equipment.

A number of speakers stressed the danger that may result from ignoring natural ventilation, pointing out that the direction and velocity of the prevailing wind may have a major influence on the operation of an industrial ventilation system.

Mr. Witheridge suggested that the standpoint of health was only one of those to be considered; safety and fire hazards, damage to equipment, nuisance and annoyance factors all may be part of the problem of industrial ventilation. He suggested that the scope of the Society's work, in conjunction with other groups, should be the control of air contaminants within industry, not limited to those strictly considered as health hazards.

Mr. Tasker pointed out that, in this, as in other problems, the Society's Research Laboratory must perform its duty to three groups, separate, and yet closely interconnected. There is the membership of the Society, whose basic contributions make Society research possible; the heating, ventilating and air conditioning industry which also supports the research work; and, finally, there is the wider duty to the general public who look to the Society for unbiased guidance on such problems.

He reported the progress made at the Laboratory on the analysis of state and municipal codes, but pointed out that these do not, at present, include codes covering toxic substances.

Dr. Selby stated that in present-day practice, it is the industrial hygiene engineer who finds the conditions which are harmful to health and the ventilating engineer who tries to cure them. The medical profession, however, has a definite part in this picture since they find those conditions in the employee which result from uncontrolled occupational exposures. Any attack on the problem should, therefore, be a coordinated one by all three groups.

Mr. Lewis suggested that there were four basic questions: (1) What is contamination? (2) How do you measure it? (3) How do you fulfill the conditions of minimum contamination? (4) How do you check statistical data and make an analysis of the results obtained by remedial practices?

Professor Pesterfield pointed out that at present there are several groups working independently and uncorrelated in this general field. He said that research work in industrial exhaust ventilation should be done by ventilation engineers and that meant the ASHVE. General ventilation, he continued, is not recommended in the field of industrial exhaust ventilation as a cure for many of the ills encountered. Dilution is only accepted as a last resort.

Discussion took place on the variation in the allowable dust concentrations between neighboring states; the opinion of the majority of those present was that the ASHVE should not become involved in setting standards for permissible concentrations of air contaminants but should leave this to the medical profession and to industrial hygiene engineers. The ASHVE should set about to determine mechanical means or mechanical standards whereby industry can achieve the goals set by the groups that have established permissible concentrations.

The question of the advisability of the ASHVE entering actively into problems involved in the measurement of concentrations of dust and other atmospheric contaminants was discussed at some length. The majority opinion was that the Society should accept methods and standards set by other groups rather than attempt to develop its own.

The group approved the motion: "THAT a Committee be appointed by the Chairman of the Committee on Research, to contact other organizations interested in the field of industrial ventilation in order to ascertain (a) what technical information is now available, and (b) what additional information should be made available through research, on engineering procedures for the control of industrial atmospheric conditions by means of ventilation."

Major Brandt accepted the Chairmanship of this Committee; the other members appointed were W. L. Fleisher, New York, Prof. C. M. Pesterfield, Lansing, W. N. Witheridge, Detroit, and W. C. L. Hemeon, Pittsburgh. This Committee will work with the Research Laboratory in collecting and correlating the information.

THE GUIDE 1945—23RD EDITION

THE 23rd edition—1945—of the HEATING VENTILATING AIR CONDITIONING GUIDE is being sent to members of the ASHVE and is ready for delivery to engineers, architects, students and the heating, ventilating and air conditioning industry.

While steps have been taken to observe the wartime limitations in the use of paper, a change in format has increased the amount of text per page and consequently much useful information has been added.

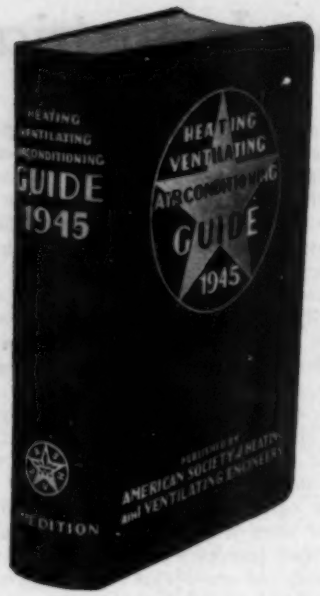
The Guide contains 48 chapters of technical data and information grouped under the general subdivisions, Principles; Heating and Cooling Load Calculations; Combustion and Consumption of Fuels; Steam and Hot Water Heating; Air Heating, Cooling and Conditioning; Automatic Controls, Instruments and Motors, Special Applications and Miscellaneous.

Among the features which add particularly to the value of the new edition are some of the following: The chapter on Panel Heating and Radiant Heating has been completely rewritten so that the first part deals with the influence of radiant heat upon the occupant and the latter part presents a new method for practical calculation of a panel heating system. An illustrative problem indicates simplifying assumptions which may be used to reduce the work required to design a satisfactory system.

The rewritten chapter on Motors and Motor Controls includes typical performance curves and recommended control combinations for motors as well as typical motor specifications.

Under Heat Transmission of Building Materials the use of separate columns for values of k and C will facilitate use of the tables of conductivities. Several materials have been added to the list for which heat transmission coefficients are given. A column of average annual minimum temperatures has been added to the table of Climatic Conditions in the chapter on Heating Load.

Selection of chimneys for gas appliances will be facilitated by a new chart in the chapter on Chimneys. In bringing the chapter on Automatic Fuel Burning Equipment up-to-date reference was made to the recently adopted codes for rating stokers.



The Guide

The chapter on Heating Boilers has been revised to include present accepted rating practice and has clarified definitions of the various terms referring to heating load.

New data on high pressure steam systems have been added to the chapter which now covers Steam Heating Systems and Piping rearranged to facilitate reference to various systems.

Heat transmission data in the chapter on Pipe Insulation have been revised to agree with accepted values for present typical insulating materials.

Among the other changes in The Guide are: revised information on cooling tower practice in the chapter on Spray Equipment; a detailed presentation of fan laws and list of definitions of fans in the chapter on Fans; extensive changes in the chapter on Industrial Exhaust Systems with addition of tables and data for practical design purpose; a new section on electronic heating in the chapter on Electric Heating; a friction loss chart for flow of water in fairly rough pipe added to chapter on Hot Water Supply.

The chapters on Terminology as well as Abbreviations, Symbols, Standards, have been amplified; and conversion equations and constants listed have been corrected to agree with latest accepted values of the National Bureau of Standards.

A 15-page detailed index, a single page quick reference table of contents, and a brief summary of chapter contents under each chapter heading provide easy reference to the subjects treated in the book.

The 1945 edition was compiled by 47 Society members and other engineers working under the supervision of the Guide Publication Committee composed of J. F. S. Collins, Jr., Pittsburgh, Pa., *Chairman*; W. C. Bevington, Indianapolis, Ind.; C. S. Leopold, Philadelphia, Pa.; G. H. Tuttle, Detroit, Mich., and T. F. Rockwell, Pittsburgh, Pa.

The Catalog Data Section of The Guide contains information on products of 212 leading manufacturers. This section is grouped into sub-divisions for convenience in locating data. It is profusely illustrated and is supplemented by an Index to Modern Equipment which greatly facilitates its use. This section is arranged, indexed, and coordinated with the Technical Data Section so that it forms a valuable source of information on modern equipment which facilitates its practical application to everyday problems.

In a total of 1216 pages the 23rd edition of The Guide contains 808 pages of technical data, 344 pages of equipment data, and the Roll of Membership of the Society. The book retains its familiar size (6x9) and external appearance and is bound in a blue cloth cover stamped in gold.

WORSHAM IN NEW POST

According to a recent announcement, Herman Worsham has been appointed manager of the War Products Training Service, Frigidaire Division, General Motors Corp., Dayton, Ohio. Mr. Worsham has been associated with Frigidaire for over 10 years. His first assignment was as zone engineer for the air conditioning section in the eastern area, and in 1936 he became the New York representative in the National Business Department. In 1937 he moved to Dayton as chief engineer of the department. Three years later he took over General Motors contacts for the Commercial and Air Conditioning Department. Since 1942 he has served as an instructor in the War Products Training Service Department.

Members on Active Duty[1]

U. S. Army

ADAIR, J. S., Sgt., 20th T. S. S.
ALVAREZ, Joaquin, Cpl., Hq. Det. 1st Bn.

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BACHMANN, A. J., S/Sgt., Bombardier Trng. Sqdn.
BACHOFER, H. A., Jr., T/Sgt., 983rd Bomb Sqdn.
BADGETT, W. H., Lt. Col., Infantry.
BARNES, H. S., Capt., 99th C. A. (aa).
BERNARD, E. L., Capt., Hq. 3rd Army, C. E.
BERZELIUS, C. E., Lt. Col., T. C.
BICHOWSKY, F. R., O.R.S., Air Support Command.
BILLINGSLEY, O. F. H., II, Pvt., 185th Pepl. Co., 43rd Bn.
BODMER, Emmanuel, Lt., Air Corps.
BOYD, R. L., Jr., 2nd Lt., Hq. Sec. Service, C.U. 1976.
BRANDT, A. D., Sc. D., U.S.P.H.S., Ordnance.
BROWN, H. J., 1st Lt., Ordnance.
BRUNDAGE, F. W., 1st Lt., 423rd C.A.
BRYAN, W. L., Jr., Lt., Hygiene Unit.
BURNS, F. G., Major, Infantry.

•

CAMPBELL, A. Q., Jr., Capt., F.A.
CAMPBELL, G. W., Major, Air Corps.
CANNON, V. K., Capt., Q.M.C.
CARLOCK, M. F., Capt., C.E.
CASKEY, L. H., Jr., Capt., C.E.
CHAPIN, H. G., Capt., Air Corps.
CHASE, R. E., Jr., Lt., Air Transport Command.
CHEESEMAN, E. W., Major, Personnel Officer, Hq. 1004 Communication.
CLARK, A. C., Capt., F.A.
CLARK, J. R., Sgt., 24th, Air Depot Group.
CLEMENS, J. D., Major, Air Corps.
CLOW, S. A., 1st Lt., Signal Corps.
COLBY, J. H., Lt. Col.
COST, G. W., 1st Lt., Air Corps.
CRAWFORD, A. C., Capt., Q.M.C.
CROLEY, J. G., Capt., C.A.
CROPPER, R. O., Major, Q.M.C.

•

DABBS, J. T., Capt., C.A.
DANIELSON, W. A., Brig. Gen., U.S.A.
DAVIS, M. M., Pvt., Air Corps.
DEAN, David, W/O, 30th ERTC.
DELAUREAL, W. D., Capt.
DEUTH, G. Q., Pvt., Co. C, 150th Bn.
DIAMOND, D. D., S/Sgt., Co. H., 15th STR.
DICK, H. S., Pvt., Co. A, 361st Engrs.
DICKSON, D. R., 1st Lt., Air Corps.
DICKSON, R. W., Jr., Major, Air Corps.
DRUM, L. J., Jr., Capt., C.E.
DYER, W. S., S/Sgt.

•

ESCHENBACH, S. P., Major, Hq. 2698 Tech. Supvr. Reg't.

•

FALK, D. S., Asst. Ind. Hyg. Engr., USPHS.
FARLEY, W. S., Capt., 104th Q.M.C.
FELDSTEIN, Harold, Major, Ordnance.
FERDERBER, M. B., Capt., M.C.
FITZGERALD, W. E., Capt., 99th Infantry Div.
FLARSHEIM, C. A., 1st Lt., A.A.F. Trng. Aids Div.
FORDERBRUGGEN, K. J., Lt. Col., 255th A.A.A. Bn.
FOSTER, J. G., Lt., Air Corps.
FRANKLIN, S. H., Jr., Major, Ordnance.
FREEMAN, A. W., Capt., Air Corps.
FRIEDLINE, J. M., Capt., C.E.
FRIEDMAN, D. H., Jr., Major, C.E. Post Engr.

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GAULT, G. W., Capt., C.E.
GEBEL, K. M., Cpl., Air Corps.
GODER, Elliot, Sgt., Cushing General Hospital.
GOLDMANN, PHILIPP, Pvt., Co. A, 203rd Bn.
GONZALES, R. A., Major, Ordnance.
GOULD, J. L., Pilot, Air Corps.
GRABMAN, H. B., 1st Lt., 95th Engrs. Reg't.

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HAMLIN, J. B., Capt., C.E.
HAWES, H. D., Lt., Instructor, A.A. School.
HENDRICKSON, W. B., S/Sgt., Air Corps School.
HERBERT, J. S., 1st Lt., Co. A, 385th Engrs. Bn.
HERBERT, R. M., Lt., Air Corps.
HILL, Edward, Jr., Capt., F.A.
HINNANT, C. H., Jr., Major, C.E.
HOLMES, R. E., Capt., Ordnance.
HOOVER, W. L., 1st Lt., C.E.
HUBBUCH, N. J., 1st Lt., Air Corps.
HUGHES, Samuel, Sgt., Infantry.
HUNT, MacDonald, Capt., C. E.
HUST, C. E., Capt., Ordnance.
HUTCHINSON, B. L., Jr., Lt., Air Corps.

•

IBISON, J. L., Major, Post Engr.
INMAN, C. M., 1st Lt., Air Corps.

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JAKOBY, A. C., Pfc., Signal Corps.
JONES, H. S., Lt., 17th Air Depot Group.
JONES, J. T., Capt., E.R.C.

•

KACZENSKI, Chester, Pvt., Co. A, 750th Ry. OPN. Bn.
KELLOGG, W. T., Major, Air Corps.
KELLY, Olin A., A/C, Air Corps.
KILLOREN, D. E., 1st Lt., Hq. Co., 15th Infantry.
KLUCKHUHN, F. H., A/C, A.A.F.T.S.
KOENIG, A. C., T/Sgt., 113th Engrs. Cbt. Bn.
KOTZEBUE, R. W., Capt., C.E.
KROEKER, J. Donald, Major, C.E.
KUMMER, C. J., Major, F.A.
KURTZ, R. W., Capt., Ordnance.

•

LANGAN, James, Pfc., C.I.T.
LARSON, C. P., Warrant Officer (jg).
LASETER, F. L., 1st Lt., C.E.
LENONE, J. M., Lt. Col., C.E.
LEUPOLD, G. L., Capt., Signal Corps.
LEWIS, H. F., Major, Infantry.
LIFTON, David, Lt., Air Corps.
LIGHT, J. C., Major, Ordnance.
LLOYD, E. H., Capt., A.U.S., C.E.
LONG, W. E., Capt., Signal Corps.

•

MACEACHIN, G. C., Major, Engrs. Aviation Bn.
MACGREGOR, C. M., Lt. Col., Ordnance.
MACMILLAN, A. R., Col., Air Corps.
MALIN, B. S., Capt., Ordnance.
MARINO, F. A., T/Sgt. (overseas).
MARSHALL, T. A., Capt., C.E.
MARSTON, A. D., Lt. Col., C.E.
MCCAIN, H. King, Major, C.E.
MCCLUNG, T. H., Capt., F. A.
MCDERMOTT, J. P., Major, C.E.
MCGOWN, F. H., Jr., Cpl., 7th T.S.S.
MCKAY, A. W., Major, Ordnance.
MEATES, R. F., Sgt., 482 Q.M.C.
MENDITCH, Barney, Cpl., 134th M.P.
MOORE, H. W., 1st Lt., Ordnance.
MORAWECK, A. H., Jr., Capt., Cavalry.
MORTON, H. S., Lt. Col., Ordnance.

•

NEAL, J. P., Capt., Ordnance.
NELSON, A. W., Major, C.E.
NEVIN, J. F., Capt., Eastern Command.
NORRINGTON, W. L., Capt., Ordnance.

•

ORGELMAN, G. H., Btry. A, 140 AAA.
OTTS, J. G., Capt., Ordnance.

•

PARKER, R. A., 1st Lt., 749th M.P.
PAWKETT, L. S., Capt., Air Corps.
PEISER, M. B., 1st Lt., Air Corps.
PELLMOUNTER, T. V., 2nd Lt., 55th Ordnance.
PETERSON, J. R., Pfc., Co. B, 1525 Serv. Unit.
PHILLIPS, R. H., 1st Lt., Infantry.
PHILLIPS, W. L., Major, Air Corps.
PLEUTHNER, R. L., 2nd Lt., Air Corps.
PLOSKEY, E. J., Sgt., 40th Ordnance.
PRAWL, F. E., Major, Ordnance.
PREBENSEN, H. J., Major, Ordnance.
PRICE, C. F., Lt., Q.M.C.

•

REIF, A. F., Col., 74th Infantry.
RHEAULT, W. E., Capt., C.E.
RHINE, G. R., Major, Ordnance.
RICHARDS, G. H., Capt., C.E.
RIESECK, W. L., Lt., C.E. (Reserve).
ROBERTS, H. P., T/Sgt., H. S. Co., 1307 Engrs. G.S. Reg't.
ROSSITER, I. J., Capt., A.C.
ROTHMAN, S. C., Capt., 2nd S.C. Laboratory.
RUEMMELE, A. M., 1st Lt., Ordnance.

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SACHS, Sam, Pvt., C.E.
SANDERS, C. M., Jr., Lt., Signal Corps.
SANDFORT, J. F., Capt., 303 F.A. Bn.
SATTERLEE, H. A., Capt., Ordnance.
SAURWEIN, G. K., Major, Ordnance.
SCHNEEBERG, F. H., Sgt., Q.M.C.
SCHLICK, P. F., Col., C.A.
SCHROEDER, W. R., Pvt., 345th Infantry.
SEMEL, Edward, Pfc., 442nd Fighter Sqdn., Air Corps.
SHARP, J. R., Lt. Col., C.E.
SHEARER, W. A., Jr., 2nd Lt., C.E.
SHELL, J. D., Lt., C.E.
SLOANE, D. J., 56th General Hospital.
SMITH, W. P., Jr., Pfc., Engrs., Special Service Reg't.
SNYDER, E. F., Jr., Capt., C.E.
SNYDER, E. J., 2nd Lt., C.E.

[1]Compiled as of March 31, 1945.

SOBEL, Frank, Pvt., Co. A, 101 M.B. Bn.
SOMMERFIELD, S. S., Pvt., Co. B.
SPENCE, R. A., Capt., Ordnance.
STENGEL, F. J., Capt., C. E.
STERNER, D. S., Capt., 282nd Q.M.C.
STEVENS, E. K., Major, Liaison Officer.
STEVENS, K. M., Major, C.A.
STROTHER, W. E., Capt., C.E.
SUTCH, H. C., Capt., Umatilla Ordnance Depot.

•

TICHENER, L. R., Jr., Lt., Range Officer.
TRAYNOR, H. S., Major, C.E.
TUTHILL, A. F., 2nd Lt., Air Corps.

•

VAN NOUHUYS, H. C., Capt., Signal Corps.
VINSON, N. L., 1st Lt., C.E.
VOLK, G. H., Cpl., 6th Photo Sqdn. (Comp.) A.A.F.

WANGSGAARD, Dee, 1st Lt., N.M.B.A.-U. S.
WARREN, R. M., Lt., Air Corps.
WATSON, G. M., Lt., G.H.D. of H.D.C.
WEATHERBY, E. P., Jr., Major, Air Corps.
WEAVER, J. van O., Lt. Col., Air Corps.
WEBSTER, Warren, Jr., Major, Ordnance.
WERNER, P. H., Capt., Signal Corps.
WESTOVER, Wendell, Col., U.S.A.
WILLIAMS, H. E., Pfc., Air Transport Section.
WILLS, F. W., Lt., 5th Airforce Flying Trng. Det.
WILSON, W. E., Lt. Col., S.W.T.C.
WOLIN, Milton W., Lt., Air Corps.

•

ZIEGLER, D. D., Lt., Air Corps.
ZINK, D. E., Col., G.S.C., 1st Arm'd. Corps.

U. S. Navy

AKERS, G. W., Capt., U.S. Navy Yard.
AMBROSE, A. H., S 1/c, U. S.N.
ANDERSON, D. B., Lt. (jg), USNR.
ANDREWS, W. G., Ch. Mach., A-V (s), USNR.
ARENBERG, M. K., Lt. Comdr., USNR.
ARVIDSON, E. R., Lt. (jg), USNR.
ASH, R. S., Lt., S (E), USNR.
AUSTIN, W. H., Lt., USNR.

•

BABER, J. E., Lt. Comdr., USNR.
BAKER, H. L., Jr., Lt. (jg), USNR.
BAKER, R. H., Comdr., USNR.
BAKKO, Reuben, AMM 1/c, N.A.S.
BASTEDO, G. R., Ensign, USNR.
BENSINGER, Mark, Lt. (jg), USNR.
BIBLE, H. U., Lt. (jg), USNR.
BLAIR, D. W., Cpl., USMCR.
BOUILLON, Lincoln, Lt., 92nd M.C.B., USNR.
BOWLER, R. W., Ensign, USNR.
BOYD, S. W., Lt., USNR.
BRAUN, C. R., Jr., Lt. (jg), USNR.
BREYER, Frederick, Ensign, USNR.
BRISSENDEN, C. W., Lt., USNR.
BULL, Frederick W., Lt., USNR.
BURGES, J. H. M., RT, Apprentice Seaman, U.S. Naval Trng. Station.
BURTON, W. R., W/O, USNR.

•

CAMPBELL, G. S., Lt., USNR.
CAMPBELL, R. P., Ensign, USNR.
CARTER, J. H., Lt., USNR.
CARY, E. B., Capt. (CEC), USNR.
CHAPMAN, W. A., Jr., Lt. Comdr., USNR.
CHASE, J. C., Lt., USNR.
CHILDS, L. A., Lt., USNR.
CHIPMAN, E. E., Lt. (jg), U.S.S. Litchfield.
COOPERMAN, Edward, S/2c, ABHTU, NAS.
COVER, R. R., Lt. (jg), USNR.
CURLEY, E. I., Lt., USNR.
CURRY, R. F., S 2/c, N.A.T.B.

•

DADDARIO, F. T., Lt. (jg), USNR.
DANOWITZ, C. J., Ensign, USNR.
DAVIDSON, J. C., Lt., USNR.
DAVIS, Charles, Chief Petty Officer, USNR (Seabees)
DEAN, F. J., Jr., Lt. (jg), USNR.
DOMINY, C. B., Ensign, USNR.
DOVENER, R. F., Lt., USNR.
DRIEMEYER, F. C., Lt. (jg), USNR.

•

EGGERS, W. K., Lt. (jg), USNR.
EUTSLER, E. E., Jr., Lt. Comdr., USNR.
EVANS, R. W., Lt. Comdr. (CEC)-V (s), USNR.
EVERETTS, John, Jr., Lt. Comdr., USNR.

•

FLORETH, J. J., Lt. (jg), USNR.
FLY, E. P., Hq. Co. 80th, USNCB.
FORBES, H. B., Jr., Lt., USNR.
FULLER, R. A., Lt. Comdr., USNR.
FULLMAN, J. B., Lt. (jg), USNR.

•

GODFREY, J. E., Ensign, USNR.
GREGG, S. L., Lt. Comdr, USNR.
GRIEST, K. C., W/O. (CEC), USNR.
GRIFFIN, C. J., Lt. (jg), USNR.
GRIFFITH, H. T., Lt., USNR.

•

HARRIGAN, E. R., Lt., USNR.
HART, J. H., Lt., USNR.
HELLAND, A. E., Lt., U.S.S. Kline.
HENDRIX, T. K., Ensign, U.S.S., LST 267.
HERMAN, N. B., Lt. (jg), USNR.
HERO, G. A., Jr., Lt. Comdr., USNR.
HERRE, H. A., Lt. (jg), USNR.
HERTZLER, J. R., Lt., USNR.
HOLDEN, R. G., Lt., USNR.
HOLLAND, G. R., MM 1/c, USNR.
HOLLAND, W. T., Lt., USNR.
HONEY, R. L., MMG 3/c, USNR.
HUGHES, Charles, Lt. (CEC), USNR.

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IVERSON, H. R., Lt. (jg), USNR.

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JOHNSTON, R. M., Lt. (jg), USNR.
JORDY, J. J., Lt., USNR.
KAHN, C. R., Jr., Lt., USNR.
KAYSER, P. G., Ensign, USNR.
KEYES, M. W., Lt. (jg), USNR.
KILLIAN, W. J., Lt., USNR.
KLINK, E. J., Ensign, U.S.S. Tennessee.
KOLASA, M. J., Lt. (jg), USNR.
KOLB, R. P., Lt. Comdr., USNR.
KUNEN, H. K., Ensign, USNR.

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LADD, David, Lt. Comdr., USNR.
LANDAUER, L. L., Lt. Comdr. (CEC), USNR.
LANGE, F. F., Lt., USNR.
LEE, R. J., Lt. (jg), USNR.
LEINBERGER, R. J. P., F 2/c, USNTC.
LEVINE, L. J., Ensign, USNR.
LEVITT, L. L., Lt., USNR.
LEWIS, G. V., Pfc., Engrg. Bn. USMC.
LIEBLICH, Murray, Lt. (jg), USNR.
LOCKE, R. A., Lt. Comdr., USNR.
LONG, E. J., Jr., Ensign (E-US), USNR.
LOUGHRAN, P. H., Jr., Ensign, D-V (s), USNR.
LUTTRELL, L. W., Ch. Engrg. Draftsman, USCG Hq.
LYFORD, R. G., Ensign, USNR.
LYON, D. M., Sgt., USMC.

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MABLEY, L. C., Lt. Comdr., USNR.
MATHEKA, C. R., U.S.S. Tattnall.
MATTHIES, L. A., Lt., USNR.
MAY, M. F., Lt. Comdr., USNR.
MCCORMICK, G. W., Jr., Capt., USMC.
MCDOWELL, H. L., Lt. (jg), USNR.
MELTON, R. D., C.M. 1/c.
MILLARD, J. W., Lt., Organized Reserve.
MINOR, J. E., Lt., USNR.
MITCHELL, A. E., Lt. (jg), USNR.
MITCHELL, A. J., Lt. (jg), USNR.
MORSE, L. S., Jr., Lt. (jg), USNR.

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NOTTBERG, Henry, Jr., Seabees.
NOYES, R. R., Ensign (AVS), USNR.

•

PAETZ, G. A., Lt., USNR.
PAINE, H. A., Lt. (jg), USNR.
PARKINSON, J. S., Lt. Comdr., USNR.
PELLER, Leonard, Lt. (jg), USNR.
PORTER, N. E., Ensign, USNR.
POTTER, J. R., Lt., USNR.

•

QUEER, E. R., Lt. Comdr., USNR.

•

RAINSON, S. J., 2/c Machinist Mate.
RAISLER, R. K., Lt. Comdr., USNR.
RAY, G. E., Elect. Mate 2/c, USCG.
REED, W. H., III, Lt. (jg), USNR.
RILEY, J. N., Lt. (jg) E-V (s), USNR.
RODEE, E. J., Lt., USNR.
RODKIN, D. B., Ensign, USNR.
ROGERS, C. S., Lt. (jg), USNR.

•

SCHAUER, R. A., CMM, USNR.
SCHECHTER, J. E., Lt., USNTS.
SGAMBATI, A. P., USNR.
SHAPIRO, C. A., Lt., USNR.
SIMPSON, R. L., Lt. (jg), USNR.
SMITH, C. F., Jr., Lt. (jg), USNR.
SPITZLEY, J. H., MM 2/c.
STACEY, A. E., Jr., Capt., USNR.
STACK, A. E., Lt., USNR.

STEEL, R. J., Lt., USNR.
STERNE, C. M., Lt. Comdr., USNR.
SULLIVAN, T. J., Lt. (jg), USNR.

•

TIMMIS, W. W., Lt. Comdr., USNR.
TRACY, W. E., Lt. (jg), USNR.
TURNER, J. P., Jr., Lt. (jg), USNR.

•

URDAHL, T. H., Capt., USNR.

•

VAN ALSBURG, J. H., Lt., USNR.
VERVOORT, E. L., Lt. (jg), USNR.
VETLESEN, G. U., Lt. Comdr., USNR.

•

WALDEN, H. K., C.S.F., USNR.
WESTPHAL, N. E., Lt., U.S.S. Canberra, USNR.
WIDDOWFIELD, A. S., Lt., USNR.
WILDMAN, E. L., Lt., USNR.
WILLIAMS, F. H., Lt. (jg), USNR.
WILLIAMS, G. E., A/S, USNCTC.
WILSON, A. A., Capt., USMCR.
WILSON, A. M., Ensign, USNR.
WORKMAN, A. E., Lt. (jg), USNR.
WYLD, R. G., Lt., USNR.

•

YOUNGER, J. R., Sp. 3/c (T), USNR.

•

ZINTEL, G. V., Lt. (jg) USNR.
ZUROW, W. A., Lt., USNR.
ZYNDA, J. R., Ensign, USNR.

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Rank and Branch of Service Unknown

BATES, J. H.
BEATTY, J. W.
BECHTOL, J. J.
BLUM, R. J., Jr.
BRANIFF, P. R.
BURNS, R. O.

COE, S. A.

DILLENDER, E. A.

FAXON, H. C.

GREEN, E. W.

HOLMES, A. D.
HOLZER, R. J., Jr.,
HUFF, J. M.

JOHNSON, L. O.

KALLUSCH, H. A.
KAUFMAN, A. M.
KERBEL, Jesse,

MORRISON, W. L.

ORMISTON, J. B.

POWERS, R. W.

RAMSEUR, V. D., Jr.
REARDON, J. F.
RODEFFER, E. W.
ROPER, R. F.
ROSER, Edward, III.
ROSS, D. S.

SCHMITT, W. C.
SIEGEL, D. E.

TUTSCH, R. J.

VON ROSENBERG, P. C.

WRIGHT, N. S., Jr.

YEAGER, G. F.

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Members in Allied Service

ARMOUR, E. G., P/O, RCAF.

BAND, J. P.*
BARRETT, C. M., Capt., Canadian Army, 5 C.I.B.H.S.
BELLMAN, J. V., Ch. Petty Officer, Naval Service Hq.
BISHOP, J. W., Lt. Col., Canadian Active Service Forces.
BOWERMAN, E. L., Fl/Lt., RCAF.
BUTT, Roderick E. W.*.

DANIEL, W. E., 2nd Lt., Royal Artillery.
DOWLER, E. A., Lt., O.S. (E) Branch C.M.H.Q., Canadian Army in England.

FOX, J. H., Lt. Col., Ordnance Co., Canadian Army.

HILL, H. G., Sub. Lt., Engr., RCNVR.
HOLE, Kenneth, Sqdn. Leader, RAF.

JOHNS, C. F., Sqdn. Leader, RCAF.

KITCHEN, W. H. J., Electrical Lt., RCNVR.

LABONNE, Henri, Capt., Canadian Army.

MACLACHLAN, V. D., Fl/Lt. RCNVR.
MARRINER, J. M. S., Lt. Comdr., RCNVR.
MCDONALD, Ivan, Capt., Winnipeg Grenadiers.

NEVIN, J. F., Capt., Hq., Eastern Command.
NORFOLK, L. W., Lt. Col., H. M. Forces, Royal Engrs.
NOVOLANSKY, S. I., Fl/Sgt., RCAF.

PENNOCK, W. B., Lt. Col., RCE, 8th Canadian Div.
POUGHER, B. R. E., Sgt. 110 (el) A. T. Coy R. E.
PRICE, E. H., Capt., Q.M.C., RCE.
PRYKE, J. K. M., Capt., Royal Army Ordnance Corps.

RICHARDSON, R. D., Sgt., Bombardier, Royal Regt. Artillery.
ROBINSON, Jack A.*

SMITH, G. E., Major, RCE, 5th Arm'd Div.

WILKINSON, Arthur, Fl/Lt., RCAF.
WOOD, A. W., Fl/Lt., RCAF.

*Rank and branch of service unknown.

Killed in Action

FOSTER, Phil H., Wing Commander in RAF, 1942 (Flin Flon, Manitoba, Canada).

ROSAS, Milton L., First Lieut., Pilot on Liberator Bomber, June 20, 1944 (St. Paul, Minn.)

TEMPLE, Harold L., Flying Officer, RAF, August 10, 1943 (London, England).

P. O. WIERENGA DIES IN GRAND RAPIDS

Word has been received of the sudden death of Peter O. Wierenga, a charter member and past president of the Western Michigan Chapter of the Society, who died on February 20, from a heart attack at his home, 231 Brown Street, S. E., Grand Rapids.

Mr. Wierenga was born on August 7, 1897, in Grand Rapids, where he received his early education and spent all of his life. At an early age he entered the employ of Cox James Co., working his way up to the position of vice-president and superintendent.

He was the owner of Wierenga Bros., one of the largest roofing and sheet metal firms of Western

Michigan, and had served as president of the *Michigan Sheet Metal and Roofing Contractors Association.* His acquaintanceship in his business field was exceptionally wide.

"Pete," as he was affectionately called, was one of the most beloved members of the Western Michigan Chapter and was known to many members of the Society through his activity in Society affairs.

He took an active interest in the affairs of the Chapter since joining the Society in 1931, and served as its secretary, vice-president and president in 1933-34 and 1935, respectively, and as a member of its board of governors in 1936.

He was also a member of the Lions Club and a past president of the Grand Rapids Builders and Traders Exchange.

A special tribute to Mr. Wierenga is being planned for the April meeting of the Western Michigan Chapter.

The Officers and Council of the American Society of Heating and Ventilating Engineers extend their sincere sympathy to his widow, Mrs. Selma Wierenga, his son, Roger and to his daughter, Nancy.

W. L. Fleisher

John Howatt

E. T. Murphy

C. A. Miller

NOW LIFE MEMBERS

Among the honored few who have now joined the ranks of Life Members of the American Society of Heating and Ventilating Engineers are: W. E. Carle, Richmond, Va.; Walter L. Fleisher, New York, N. Y.; John Howatt, Chicago, Ill.; Carl W. Johnson, Chicago, Ill.; Alfred Jones, Lancaster, Pa.; James T. J. Mellon, Philadelphia, Pa.; Charles A. Miller, New York, N. Y.; Floyd A. Miller, Chicago, Ill.; C. T. Morse, Detroit, Mich.; E. T. Murphy, Syracuse, N. Y.; and E. L. Wilder, Rochester, N. Y.

W. E. Carle

C. W. Johnson

Alfred Jones

C. T. Morse

E. L. Wilder

SUMMARY OF LOCAL CHAPTER MEETINGS

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Cincinnati	Feb. 13	The Future of Hot Water Heating	R. E. Moore, Vice-Pres., Bell & Gossett Co., Morton Grove, Ill.	Question and Answer period followed Pres. G. V. Sutfin reported on Boston meeting	30	0.61
Central New York	Jan. 19	The Flow of Air and Gases in Various Systems	S. H. Downs, Kalamazoo, Mich., Pres. of ASHVE	Election of Officers Pres. Downs presented Charter		
	Nov. 21	Organizational meeting		A. V. Hutchinson, Secy. of ASHVE, spoke on rapid growth of Society		
		Research	W. H. Carrier, Past Pres. of ASHVE			
		Highlights from the History of Heating and Ventilating	W. H. Driscoll, Past Pres. of ASHVE			
Delta	Feb. 15	The Story of the Sylphon Bellows (film)	Presented by W. H. Grant, Jr., Warren Webster Co., New Orleans	G. C. Kerr discussed The Guide, Constitution and By-Laws, and the drive for new members	21	0.49
		Annual Meeting in Boston, and Society Activities	A. V. Hutchinson, Secy. ASHVE, New York			

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Golden Gate	Feb. 7	Selecting a Heating System	K. F. Baldwin, Head, Htg. Dept., W. D. Peugh Associates, Pleasanton, Calif.	C. L. Peterson, Chapter Delegate, reported on Annual Meeting in Boston	42	0.54
Illinois	Feb. 12	Some of Benjamin Franklin's Many Accomplishments	Reviewed by O. J. Prentice, Life Member of ASHVE and Dir. of Publicity and Public Relations, C. A. Dunham Co., Chicago	C. E. Price led group in pledge of allegiance to the Flag and in singing "America" A. O. May reported on Annual Meeting in Boston	78	0.49
Indiana	Feb. 23	Automotive and Aviation Heat Transfer Surface Development.	L. P. Saunders, Chief Engr., Research Engrg., Harrison Radiator Div., General Motors, and Treas. of ASHVE	Mr. Saunders also reviewed work of Society on Standards and Codes	41	
	Jan. 26	Radiant Heating	F. W. Hutchinson, University of California, Berkeley	Talk was supplemented by slides showing numerous installations made in England; lively discussion followed	61	0.65
Iowa	Feb. 7	Productive Energy of Human Beings and Its Relation to Economics and Sociology	Brig. Gen. W. A. Danielson, U.S.A., Memphis, Tenn.	Many interesting facts presented by Gen. Danielson	24	
Kansas City	Mar. 12	Joint Meeting with ASME Purposes and Functions of Midwest Research Institute	Dr. Harold Vagtborg, Pres. of the Institute	L. T. Mart presided as chairman	100	1.2
	Jan. 3	Venting Valves	Ferdinand Jehle, Dir. of Engrg., Hoffman Specialty Co., Indianapolis, Ind.	Mr. Dahms, Allis-Chalmers, gave short talk on V-Belt Drives	48	0.53
	Dec. 4	Daylight Engineering in Homes of Tomorrow	R. W. Anderson, Mgr., Dist. Div., Libby-Owens-Ford Glass Co.	He showed interesting slides of the "Solar House."	48	0.56
	Nov. 6	Condensation Within Buildings, Its Causes and Remedies	Prof. F. B. Rowley, Dir. of Experiment Sta., University of Minnesota	Slides were shown covering tests made and the tabular data on effectiveness of various types of vapor barriers.	67	
Manitoba	Feb. 22	Detailed Report on Annual Meeting in Boston	Einar Anderson, Chapter Delegate	Report on membership submitted by F. L. Chester	14	
Massachusetts	Feb. 20	Report of General Chairman of the 51st Annual Meeting of Society	Earl G. Carrier, Br. Mgr., Carrier Corp., Boston, Mass.	Past Pres. W. T. Jones expressed the thanks of the Society for the fine Meeting in Boston	28	0.40
Memphis	Feb. 5	Psychology and the Thermostat	F. C. McIntosh, Br. Mgr., Johnson Service Co., Pittsburgh, Pa.		35	1.40

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Michigan	Mar. 12	Past Presidents' Night (with 16 Past Presidents in attendance)	Messrs. Harms, Wilde, Johnson, McIntire, Boales, Dubry, Paetz, Winans, Milward, Feely, Linsenmeyer, Randall, Tuttle, Kilner, Shea and Sanford	M. B. Shea reported as chairman of Membership Committee An official Army motion picture "Yankee Noodle" was shown	67	0.56
		Research in Industry	Cyril Tasker, Dir. of Research, ASHVE, Cleveland, Ohio	A discussion followed Mr. Tasker's talk on Research		
Minnesota	Mar. 5	Conduit System of Air Conditioning	H. C. Hoffman, M. E., Carrier Corp.	L. C. Gross reported for Nominating Committee	65	
	Feb. 15	Oil as a Postwar Fuel	C. E. Lewis, Vice-Pres., Perfex Corp., Milwaukee, Wis.	F. W. Legler gave a report on the 51st Annual Meeting in Boston	51	
Montreal	Feb. 19	Town Planning (background and history of the Canadian Housing Acts since 1935)	Prof. P. E. Nobbs	R. F. Wormley reported on 51st Annual Meeting as Secy. of Chapter Delegates Nominating Committee	32	
New York	Feb. 19	Panel Heating and Radiant Heating	T. Napier Adlam, Vice-Pres.-Gen. Mgr., Sarco Co., Inc., New York	W. E. Heibel gave a report for the Nominating Committee	95	0.44
North Carolina	Feb. 23	Discussion of Proposed House Bill in Raleigh to create a Statewide Plumbing, Heating and Air Conditioning Code of Minimum Requirement	R. Van Sick called attention to Bill. A resolution endorsing Bill was adopted to send to North Carolina State Board of Health	F. E. P. Klages reported in detail on 51st Annual Meeting in Boston	20	0.43
North Texas	Feb. 19	The Individual Views the Present Income Tax Situation	S. L. Mayo, Asst. Col. of Internal Revenue, Dallas	Mr. Mayo's talk was well received and a round table discussion followed	32	0.66
Northern Ohio	Feb. 12	High Temperature Measurements	K. H. Flint, A.G.A. Laboratories, Cleveland	W. A. Evans reported as Chapter Delegate	70	0.57
		High Temperature and High Pressure Power Plants	Fred G. Ely, Babcock & Wilcox	Mr. Ely illustrated his talk with slides of mobile electric power ships		
Ontario	Mar. 5	The Architect, His Duties and Responsibilities in Relation to Comfort Heating	Forsay Page	H. D. Henion, Chm. of Nominating Committee, submitted his report	78	0.43
		Professional Engineers of the Province of Ontario	Colonel Medland			
		Current Conditions in London	J. P. Peasey, London			
Oregon	Feb. 8	Postwar Electric Heating in Homes	Jack Cochran, Bonneville Power Administration	B. F. Farnes submitted the Nominating Committee Report for T. E. Taylor	34	
Pacific Northwest	Feb. 13	Detailed Report of Annual Meeting in Boston	D. C. Griffin, Vice-Pres. of Chapter	C. W. May discussed the efforts of Office Workers Union to include the Professional Engrg. employees	33	0.43
Philadelphia	Feb. 8	Survey of Air Pollution, City of New York	A. C. Stern, Ch. Engr., Div. of Industrial Hygiene, N. Y. Dept. of Labor	Discussion followed	53	

Chapter	Meeting Date	Subject	Speakers	Other Features	Attendance	Attendance Ratio*
Rocky Mountain	Feb. 7	Solar Heat Collectors	Prof. George O. G. Lof, Colorado University	Reports by Chairmen of all standing committees	46	0.61
		Report on 51st Annual Meeting in Boston	F. L. Adams and Elmo Hall as Chapter Delegate and Alternate	Don McQuaid gave interesting account of court trial concerning death due to faulty heating installation. He explained the necessity of licensing all engineers		
St. Louis	Feb. 6	Psychology and the Thermostat	F. C. McIntosh, Br. Mgr., Johnson Service, Pittsburgh, Pa.		35	0.53
Southern California	Feb. 14	Modern Hot Water	Arthur J. Hess, Engr., English & Lauer		65	0.83
Utah	Feb. 14	Business Meeting	H. G. Richardson led discussion on suitable meeting night. The first Wednesday of each month was decided upon	E. V. Gritton reported as Chapter Delegate to Annual Meeting	20	0.77
Washington, D. C.	Feb. 14	Centrifugal Gas Compressors as Applied to Refrigeration	J. R. Chamberlain, Chief Engr., York Corp.	Fred Leser reported as Chapter Delegate to the Annual Meeting in Boston All in attendance stood in a moment of silence in memory of Comdr. F. C. Houghten	83	0.36
Western Michigan	Feb. 12	An Over-All Picture of the Society During the Past Year	S. H. Downs, Pres. of ASHVE in 1944, Kalamazoo	F. C. Warren gave his report as Chapter Delegate to the Annual Meeting in Boston.	30	0.50
		Control of Industrial Atmospheres, by W. N. Witheridge	Discussed by Prof. C. H. Pesterfield	C. H. Pesterfield reported on Nominating Committee		
Western New York	Mar. 12	Birthday celebration in honor of B. C. Candee's 75th birthday	Roswell Farnham acted as toastmaster. D. J. Mahoney presented Mr. Candee with Life Membership in Western New York Chapter	Four past presidents then presented a birthday cake with a candle for each 25 years At close of meeting a Society emblem pin with a diamond setting was given to Mr. Candee	54	
	Feb. 12	Industrial Air Conditioning and the Manufacture of Penicillin	L. T. Avery, Pres., Avery Engineering Co., Cleveland, Ohio	Sherman Strouse reported on Annual Meeting in Boston	48	
Wisconsin	Feb. 21	War Time Science and Post War Living	Dr. Gerald Wendt, Science Editor, Time, Life, and Fortune Magazines	Joint meeting with Engineers' Society of Milwaukee, E. L. Krebes, President	865	14.4
		Dialogue Description of Method of Gathering and Editing News for Weekly Magazines	Dr. Wendt and Robert Hagey, Mgr., Time, Chicago News Bureau	Latest March of Time entitled "Post War Jobs" was shown		

*The attendance ratios shown represent the meeting attenda nce divided by the Chapter membership. These will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by other local chapters and may be helpful in deciding on subjects for other chapter meetings.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the Journal of the Society or sent to the members in other approved manner as ordered by the Council. When replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 67 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by April 16, 1945, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

CANDIDATES	REFERENCES	
	Proposers	*Seconders*
ADAMSON, LAWRENCE C., Owner, Air Conditioning & Heating Service Co., Kansas City, Mo.	D. M. Allen P. C. Leffel	L. P. Heaven Frank Pexton
ALLEN, GEORGE W., Maintenance Mechanic, U. S. Coast Guard, Brooklyn, N. Y.	H. S. Birkett H. R. Heymsfield	E. J. Motley Nathan Wald
ANDERSON, ROBERT V., Lennox Furnace Co., Inc., Syracuse, N. Y.	F. E. Hockensmith C. M. Ashley	J. W. Stevens Milner Noble
BAKER, HARLAND E., Partner, H. E. Baker Co., Cleveland, Ohio.	D. E. Mormon, Jr. J. E. Wilhelm	Dennis Boggs R. H. Cutting
BALDWIN, CHARLES W., Vent. Engr., U. S. Rubber Co., North Wilbraham, Mass.	Winfield Roeder W. E. Heibel	C. L. L'Hommedieu W. L. Fleisher
BAUTTS, RAY A., Local Mgr., Arkansas Power & Light Co., Jonesboro, Ark.	N. C. Ledbetter A. T. Bevil	E. E. Scott J. B. Lammons
BEALS, A. P., Gen. Mgr., Western Service Co., Fargo, N. D.	Robert Gibbs H. B. Leeby	J. E. Rosatti C. E. Wood
BICKELL, GEORGE C., Sales Engr., Tutein Equipment Co., Pittsburgh, Pa.	E. S. Tower R. F. Metzger	T. F. Campbell E. C. Smyers
BOSTROM, H. R., Owner, Bostrom Sheetmetal Works, Minneapolis, Minn.	J. A. Craig H. R. Nichols	William McNamara Lyman Gross
CANTWELL, ALGERNON B., Solid Fuel Engr., Kansas City Coal Service Institute, Kansas City, Mo.	R. B. Mason L. P. Heaven	E. C. Waldsmith J. G. Lewis
CARNS, VERNON J., Application Engr., Minneapolis-Honeywell Regulator Co., Detroit, Mich.	G. D. Winans W. H. Old	F. C. Purcell R. L. Wilson
CHU, YAO-HAN, Graduate Student of Massachusetts Institute of Technology, Cambridge, Mass.	James Holt G. B. Wilkes	*C. L. Svenson A. L. Hesselschwerdt, Jr.
CLARK, ARTHUR E., Engr., Grinnell Co. of Canada, Ltd., Toronto, Ont., Canada.	W. H. Evans V. J. Jenkinson	A. J. Strain J. P. Fitzsimons
DAVIS, JOHN C., Pres. & Mgr., J. C. Davis, Ltd., Winnipeg, Man., Canada.	D. F. Michie F. L. Chester	Einar Anderson F. T. Ball
DAVIS, JOHN T., Sales Engr., The Trane Co., Ltd., Houston, Texas.	R. F. Taylor M. P. Noll	A. F. Barnes E. R. Thomas
DOHERTY, ROGER J., Vice-Pres., Shaw Perkins Manufacturing Co., Pittsburgh, Pa.	F. C. McIntosh E. C. Smyers	R. B. Stanger P. A. Edwards
EDWARDS, ARTHUR F., Mech. Designer, Department of Public Works, Toronto, Ont., Canada.	H. H. Angus R. P. Allsop	H. R. Roth K. L. Leitch
ENDELMAN, HARRY, Engrg. Draftsman, Navy Dept., Bureau of Ships, Washington, D. C.	G. P. Lively D. S. Berres	C. W. Porter *R. T. Moore
EWELL, WALTER A., Kaiser Engineers, Oakland, Calif.	D. J. Milligan V. J. Cucci	J. W. Markert R. N. Nyborg
FAVA, ALBERT A., Plant Engr., Atlantic Gelatin Co., Inc., Woburn, Mass.	J. R. Bergan H. M. Tarr	H. L. von Rehberg L. S. MacGann
FAY, SAMUEL C., Indus. & Home Insulation Engr., The Eagle Picher Sales Co., Cincinnati, Ohio.	H. E. Lewis S. L. North	R. F. Hahn B. J. Seckinger, Jr.
FORRESTER, CHARLES O., Mech. Engr., Federal Public Housing Authority, Atlanta, Ga.	A. H. Rumbold D. F. Lindstrom	C. L. Templin L. L. Barnes
FOX, FRANCIS J., Supvsr. of House Heat Testing, Minneapolis Gas Light Co., Minneapolis, Minn.	H. C. Mills H. M. Betts	Lyman Gross C. E. Wiser
GOELLNER, JOHN A., Pres., Monarch Metal Weather Strip Corp., St. Louis, Mo.	B. C. Simons G. B. Rodenheiser	*V. H. Hiersmeier *Morgan Schwind
GOTTSCHALL, WALTER C., Pres. & Estimator, Industrial Insulation, Inc., Pittsburgh, Pa.	E. H. Riesmeyer, Jr. F. C. McIntosh	R. B. Stanger E. C. Smyers
GRUTZMACHER, ROBERT L., Mgr., Space Htg. Div., Natural Gas Equipment, Inc., San Francisco, Calif.	S. W. Terry J. M. Marr	H. V. Hickman N. H. Peterson
HEGELE, RICHARD H., Owner & Mgr., H. W. Hegele Co., Urbana, Ohio.	J. D. Siemmons H. R. Allonier	L. J. Nichols *Ralph Harman

*Non-member.

ELMS, LLOYD J., Mech. Engr., English & Lauer, Inc., Los Angeles, Calif.

OHNSON, ROY W., Partner, Johnson-Lenz Heating & Piping Contractors, Memphis, Tenn.

ALBFLEISCH, THEODORE F., JR., Supt. of Bldgs. & Grounds, Board of Education, Glens Falls, N. Y.

EEN, R. H. S., Htg. & Vent. Draftsman, Richard Crittall & Co., Ltd., London, England.

INGSLAND, NORTON W., Publisher, Heating & Sanitary Age—Age Publications, Ltd., Toronto, Ont., Canada.

AMBECK, WALTER N., Sales Engr., Wisconsin Ice & Coal Co., Milwaukee, Wis.

ENZ, ALFRED W., Partner, Johnson-Lenz, Heating & Piping Contractors, Memphis, Tenn.

ARCONETT, VERNON G., Supt. of Purchasing, The Farquhar Furnace Co., Wilmington, Ohio. (*Advancement*)

AYNE, IVAN E., Owner, Consolidated Heating & Ventilating Co., Los Angeles, Calif.

CANDLESS, HOWARD F., Fan Engr., Moore Machinery Co., San Francisco, Calif.

CANN, JOHN L., Mgr., Plbg. & Htg. Dept., Harris Pump & Supply Co., Pittsburgh, Pa.

CULLY, ROBERT E., Sales Engr., Bay Cities Asbestos Co., Oakland, Calif.

CINTOSH, ROBERT M., Mech. Engr., Harley-Ellington & Day, Detroit, Mich.

CKAY, WILLIAM H., Supt., of Stoker Engrg. Dept., The Winnipeg Supply & Fuel Co., Ltd., Winnipeg, Man., Canada.

CMASTER, SHERMAN G., Mgr. of Htg. Dept., Richards Manufacturing Co., Grand Rapids, Mich.

LLER, WARREN W., Canadian Sales Engr., Frigidaire Products of Canada, Leaside, Ont., Canada.

RGAN, ROBERT L., Owner, Morgan Appliance Co., Houston, Texas.

PIER, CHARLES E., Sales Engr., Consolidated Engines & Machinery Co., Ltd., Toronto, Ont., Canada.

LSON, JAMES A., JR., Partner, James A. Nelson Co., San Francisco, Calif.

MBC, FRANK L., Mech. Engr., U. S. Engineers, San Francisco, Calif.

RMELEE, GEORGE V., Asst. Prof. of Mech. Engrg., Fenn College, Cleveland, Ohio.

RI, IDWAL W., Final Test Engr., Perfex Corp., Milwaukee, Wis.

LSON, OWEN D., Engr., General Air Conditioning & Heating Co., San Francisco, Calif.

CE, HAROLD C., Asst. Mgr., Air Conditioning Div., Servel, Inc., Evansville, Ind.

SSING, RALPH L., Designing Engr., Natkin & Co., Houston, Texas.

NDY, LLOYD B., Indus. Engr., Houston Lighting & Power Co., Houston, Texas.

EMEYER, EDWARD H., JR., Htg. Engr., Schaffer Heating Co., Pittsburgh, Pa. (*Advancement*)

ERTS, ERIC, Sales Repr., McDonnell & Miller and H. A. Thrush & Co., San Francisco, Calif.

SELL, JAMES R., Designer & Checker, Meadows, Critoph & Misener, Toronto, Ont., Canada.

AR, PAUL B., Field Engr., General Controls Co., Cleveland, Ohio.

F, CHARLES L., Secy.-Mgr., The Farquhar Furnace Co., Wilmington, Ohio. (*Advancement*)

REIBER, W. F., Owner, Schreiber Institute of Refrigeration, Kansas City, Mo.

WARTZ, FRED D., Cons. Engr., Lloyd & Schwartz, Los Angeles, Calif.

EHAN, JOHN T., Sales Engr., Crane O'Fallon Co., Denver, Colo.

MATE, JAMES C., Branch Mgr. & Vice-Pres., Noland Co., Inc., Atlanta, Ga.

CKLE, FRED A., Pres. & Gen. Mgr., Stickle Steam Specialties Co., Indianapolis, Ind.

SON, DE PARX, Application Engr., The Bahnson Co., Winston-Salem, N. C.

NEY, L. FOSTER, Mgr., Mulch Brothers, Hollidaysburg, Pa.

KEY, GEORGE, Sales Engr., Pease Foundry Co., Ltd., Toronto, Ont., Canada.

LEY, EDWARD D., Milwaukee Plumbing & Heating Supply Co., Milwaukee, Wis.

	A. J. Hess Harrold English	M. C. Greiner Leo Hungerford
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	F. G. Weimer Rex Vernon	M. W. Bishop H. W. Schreiber
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	A. P. Kratz F. R. Bishop	G. A. Voorhees L. G. Miller
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	Einar Anderson O. J. Hatch	F. T. Ball E. Fitzmorris
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	L. D. Greenwood J. A. Walsh	A. F. Barnes M. P. Noll
	W. H. Evans H. R. Roth	H. G. S. Murray J. P. Fitzsimons
	J. I. Sprott H. V. Hickman	N. H. Peterson K. O. Alexander
	G. M. Simonson N. H. Peterson	T. C. Douglass D. I. Murphy
	Cyril Tasker G. L. Tuve	L. G. Seigel G. B. Priester
	L. B. Miller M. W. Crew	Rex Vernon H. W. Schreiber
	D. L. Williams C. D. Williams	N. H. Peterson H. V. Hickman
	J. K. Knighton M. P. Noll	H. J. McFadden F. A. Grossman
	F. C. Brandt L. L. Ladewig	W. M. Andrews M. P. Noll
	F. C. Brandt L. L. Ladewig	W. M. Andrews M. P. Noll
	J. F. Collins, Jr. T. F. Rockwell	F. C. McIntosh P. A. Edwards
	James Gayner C. E. Bentley	J. I. Sprott H. V. Hickman
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	D. M. Allen L. P. Heaven	David Caleb J. M. Arthur, Jr.
	W. O. Stewart George Hatch	A. J. Hess Art Theobald
	H. J. Woehlke A. W. Cooper	E. J. McEahern J. H. McCabe
	D. F. Lindstrom E. R. Foss	W. J. McKinney C. L. Templin
	W. C. Bevington G. B. Supple	G. O. Jackson S. E. Fenstermaker
	Arvin Page F. E. P. Klages	James Marshall M. D. Brown
	I. H. Geiger F. C. McIntosh	*J. S. Hunter, Jr. *W. L. Faust
	William Eaton H. B. Jenney	William Philip V. J. Jenkinson
	F. G. Weimer Rex Vernon	H. W. Schreiber M. W. Bishop

Candidates Elected

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, Sec. 8, of the By-Laws, the following list of candidates elected:

MEMBERS

ADDIE, GEORGE R., Managing Director, J. G. Wagstaff, Ltd., Dukinfield, Cheshire, England.

ARCHER, WILLIAM J., Engr., Howes & Whitaker, San Francisco, Calif.

BROWN, J. MASON, Engr., Worthington Pump & Machinery Corp., Harrison, N. J.

CARPENTER, JAMES H., Director, Student Training, Carrier Corp., Syracuse, N. Y.

COLTON, FREDERICK R., Branch Mgr., Norris Warming Co., Birmingham, England.

DUDLEY, WILLIAM H., JR., Dist. Mgr., The Trane Co., New Orleans, La. *(Advancement)*

ENGELBACH, A. A., Eagle Corp., Washington, D. C.

FENSTERMAKER, SIDNEY E., JR., Sales & Design Engr., S. E. Fenstermaker & Co., Indianapolis, Ind. *(Advancement)*

FREEMAN, CASSIUS W., Chief Designer, Paul D. Bemis, Hartford, Conn.

HAAS, EMIL, JR., Managing Partner, Natkin & Co., Kansas City, Mo. *(Advancement)*

HANSON, LARS C., Asst. Dir. of Development, Carrier Corp., Syracuse, N. Y.

HILLARD, HENRY F., Chief Engr., Mountain Fuel Supply Co., Salt Lake City, Utah.

KEANE, G. F., Application Engr., Carrier Corp., Syracuse, N. Y. *(Reinstatement)*

KENNEDY, JAMES C., Htg. Engr., Edward Joy Co., Syracuse, N. Y.

KRAYENHOF, HAROLD G., Sales Mgr., The Lennox Furnace Co., Inc., Syracuse, N. Y. *(Reinstatement and Advancement)*

LAWLESS, ALBERT J., Partner, Hubbard, Rickerd & Blakeley, New Haven, Conn.

LYONS, EARL C., Htg. & Air Cond. Engr., General Engineering Co. (Canada), Ltd., Toronto, Ont., Canada.

MCCUMBER, BURTON R., Staff Asst., Carrier Corp., Syracuse, N. Y.

MCGRUER, A. E., Supvsr., Stationary Boiler Plants, Canadian Pacific Railway Co., Toronto, Ont., Canada *(Advancement)*

MCGUIRE, JAMES W., Owner, James W. McGuire, New York, N. Y.

MUEHLIG, ELMER J., Construc. Engr., F. W. Woolworth Co., Denver, Colo.

PATTERSON, JAMES C., Director of Indus. Htg. Sales, Carrier Corp., Syracuse, N. Y.

PIETSCH, HERMAN A., Chief Engr., Heater Sect., Dravo Corp., Pittsburgh, Pa.

ROBSON, PAUL D., Pres., Robson & Woese, Inc., Syracuse, N. Y.

ROTH, HERMAN P., Produc. Mgr., National Technical Laboratories, South Pasadena, Calif.

SCHLENK, HUGO, JR., Engr., The Northwest Paper Co., Cloquet, Minn.

SHAWHAN, SAMUEL F., Engr., Carrier Corp., Syracuse, N. Y.

SINGLETON, WILLIAM H., Vice-Pres., Mehring & Hanson Co., Washington, D. C.

SMITH, STANLEY K., 1st Vice-Pres., The H. B. Smith Co., Inc., Westfield, Mass.

STAINS, W. A., Chief Engr., The Lowe Stoddard Co., Los Angeles, Calif. *(Reinstatement)*

STRONG, HENRY G., Director of Sales, Transportation, Air Conditioning and Refrigeration, Carrier Corp., Syracuse, N. Y.

TUCKER, SYDNEY, Chief Engr., Fitzgibbons Boiler Co., Inc., Oswego, N. Y.

WATSON, M. BARRY, Cons. Engr., Toronto, Ont., Canada. *(Reinstatement)*

WATT, ROBERT D., Pres., Electrol Oil Burner Corp., Seattle, Wash. *(Advancement)*

WATTS, EDWARD J., Application Engr., Worthington Pump & Machinery Corp., Salt Lake City, Utah.

WHELER, A. GORDON, Engr. and Exec., House Sheet Metal Co., Syracuse, N. Y.

WILLIAMS, CHARLES R., Vice-Pres., Dickie Construction Co., Ltd., Toronto, Ont., Canada.

WILSON, MAURICE J., Engr., Carrier Corp., Syracuse, N. Y.

WYLIE, WILSON J., Asst. to Mgr., Power Dept., Toronto Hydro Electric System, Toronto, Ont., Canada.

ASSOCIATES

HEIRN, JOHN B., Sales Engr., American Radiator & Standard Sanitary Corp., Springfield, Mass.

BRIDGMAN, ROBERT L., Sales, American Radiator & Standard Sanitary Corp., Washington, D. C.

CHRISTIE, ROBERT W., Engr., United States Testing Co., Inc., Hoboken, N. J.

COCHRAN, LUCIUS D., Engr., American Welding & Manufacturing Co., Warren, Ohio.

DEBRA, FREDERICK B., Owner, Fred. B. DeBra Co., Cincinnati, O.

DOTSON, RUSSELL F., Bastian Morley Co., Inc., Atlanta, Ga.

FENNER, WALTER M., Engr., Secy.-Treas., Central Mill & Plumbing Supply Corp., Columbus, Ohio.

GEISSENHAINER, LOUIS R., Owner, L. R. Geissenhainer, Boston, Mass.

GETTINGER, EDGAR W., Prod. Design Engr., American Furnace Co., St. Louis, Mo.

GREGORY, HENRY D., Htg. Dept., Hendrie & Bolthoff Manufacturing & Supply Co., Denver, Colo.

HARTWIG, WALTER J., Mech. Engr., Service Command Engineer, Omaha, Nebr.

HAUSSER, FRED L., Partner, Ward & Hausser, Hartford, Conn.

HEACOCK, GROSVENOR W., Sales Engr., O'Brien Specialty Co., Syracuse, N. Y.

HERRMAN, DONALD D., Chief Engr., Hartzell Ind., Inc., Piqua, Ohio.

HICKEY, C. B., Sales Engr., Hendrie & Bolthoff Manufacturing & Supply Co., Denver, Colo.

KENNEDY, DON P., Engr. and Estimator, Sans Co., Jamestown, N. Y.

LYNCH, CHARLES B., Chief Engr., McCann Furnace Co., Cleveland, Ohio.

MAYCOCK, AMBROSE A., Mgr., A. A. Maycock Co., Salt Lake City, Utah.

MCCARTHY, FRANCIS W., Dist. Mgr., Minneapolis-Honeywell Regulator Co., Des Moines, Iowa.

MOONEY, MARK E., Director of Sales, Applied Refrig., Carrier Corp., Syracuse, N. Y.

PEARY, HOWARD W., Factory Engr., Boston, Mass.

PERKINS, STANLEY H., Application Engr., Minneapolis-Honeywell Regulator Co., Syracuse, N. Y.

PETTINGELL, JOHN M., Dist. Repr., American Air Filter Co., Inc., Boston, Mass.

POPE, EDWARD F., Business Mgr., Carrier Corp., Syracuse, N. Y.

PRICE, ALBERT Z., Pres. and Treas., The A. Z. Price Co., Inc., Charlotte, N. C.

RAINEY, NORMAN W., Air Cond. Engr., Danforth Co., Pittsburgh, Pa.

REICHOW, WILLIAM A., Branch Mgr., Minneapolis-Honeywell Regulator Co., Kansas City, Mo.

RIEHL, WILLIAM L., Asst. to Vice-Pres., The Union Fork & Hoe Co., Rome, N. Y.

RITCHIE, GEORGE W., General Motors Bomber Plant, Cleveland, Ohio.

ROBISON, D. J., Engr. in Charge of Indus. Dept., Mountain Fuel Supply Co., Salt Lake City, Utah.

SCHAARSCHMIDT, KARL F., Partner, Majestic Heating Co., Detroit, Mich.

SHULL, LEON F., Price Specialist, Office of Price Administration, Denver, Colo.

SHESLER, JOHN A., Field Engr., Hoffman Specialty Co., Inc., Yonkers, N. Y.

SIMPSON, HARRY, Htg. Contractor, Toronto, Ont., Canada.

SPRIGGS, CARL U., Asst. Sales Mgr., Carrier Corp., Syracuse, N. Y.

SPRINGER, JOSEPH J., Owner, Oneida Supply Co., Oneida, N. Y.

STEPHAN, CHARLES O., Owner, Stephan & Lambert, Pueblo, Colo.

STICKRATH, KENNETH J., Owner, K. J. Stickrath, McKeesport, Pa.

SWEENEY, GEORGE J., Vice-Pres. and Mgr., Air Equipment Dept., Air Devices, Inc., New York, N. Y.

WEDEBROCK, ARCH L., Staff Engr., Johns Manville, New York, N. Y.

WILLOUGHBY, JOSEPH D., Owner, F. W. Willoughby Co., Denver, Colo.

YATES, ROBERT A., Mgr., Yates & Co., Brandon, Man., Canada *(Reinstatement)*

YEAZEL, HAROLD F., Asst. Sales Mgr., The Lennox Furnace Co., Inc., Syracuse, N. Y.

ZIEMBA, WALTER P., Draftsman, N. B. Hubbard, Detroit, Mich.

JUNIORS

CHURCH, RICHARD A., Engr., Carrier Corp., Syracuse, N. Y.

DE JARLAIS, GORDON M., Test Engr., Sunbeam Electric & Manufacturing Co., Evansville, Ind.

DOVER, DONALD E., Mech. Engr., Carrier Corp., Syracuse, N. Y.

GRAY, FRANK L., JR., Engr., Carrier Corp., Chicago, Ill.

GRIELSAMER, PHILIPPE, Student Engr., Carrier International Division, Syracuse, N. Y.

ROSS, MORWICK, Lt., U.S.N.R., Bureau of Medicine & Surgery, Washington, D. C.

TAYLOR, ERIC L., Director and Tech. Adviser, The Premier Heating & Ventilating Co., Ltd., Leicester, England.

WAGNER, HARLAN C., JR., Draftsman, Newport News Shipbuilding & Dry Dock Co., Newport News, Va.

DOWNS INSTALLS CENTRAL NEW YORK CHAPTER WITH RECORD NUMBER OF CHARTER MEMBERS

S. H. Downs, Kalamazoo, president of the Society, installed Central New York chapter with a charter membership of 103, a new record, in Syracuse on January 19.

The chapter's organization meeting was held last November 21, when National Secretary A. V. Hutchinson told the group it was 1944's fifth new chapter, bringing the year's total of new candidates to 630. At that time, two past presidents, Dr. W. H. Carrier and W. H. Driscoll, were guest speakers. Dr. Carrier discussed the importance of cooperation in testing and research, and the Society's contribution to America's eminence. Mr. Driscoll gave highlights from the history of heating and ventilating, and, like Dr. Carrier, urged eligible members to join the local chapter being formed.

At the installation meeting the organization committee headed by M. N. Noble as chairman announced nominations for chapter officials. Following Mr. Downs' presentation of the charter these officers were elected by unanimous vote: Pres., C. M. Ashley; Vice-Pres., Carl F. Woese; Secy., F. E. Hockensmith; Treas., R. E. Cherne. Board of Governors: C. O. Mackey, M. N. Noble and H. F. Randolph.

Dr. Carrier and Mr. Noble were named the new chapter's representatives at the 51st Annual Meeting in Boston.

In addition to describing the trend of leadership in engineering when making formal presentation of the new chapter's charter, President Downs afterward gave a very interesting and informative talk on "The Flow of Air and Gases in Various Systems."

J. H. WALKER ELECTED VICE-PRES., DETROIT EDISON

James Herbert Walker was elected vice president of The Detroit Edison Co., Detroit, Mich., at a meeting of the Board of Directors on March 20. He was employed by The Detroit Edison Co. in 1912, following his graduation from the University of Michigan with a degree in mechanical engineering.

For many years he has been superintendent of the company's central heating department, which supplies steam service to the principal buildings in downtown Detroit. As assistant to the general manager Mr. Walker served in organization planning matters, and as a consultant on various commercial and economic problems affecting special industrial service. He has a wide experience in company affairs.

Mr. Walker is an honorary member and a past president of the *National District Heating Association*. Mr. Walker is author of a number of papers on heating and ventilating, and co-author of a text book on this subject. He and Sabin Crocker of Detroit Edison have published a handbook on piping. For years he has taken an active part in the work of several scientific societies. He joined ASHVE in 1916, has served as Vice President, chairman of Committee on Research, chairman of the Guide Publication Committee, Finance, Standards, Executive, and many other technical committees.

American Society of Heating and Ventilating Engineers

Headquarters
51 Madison Ave., New York 10, N. Y.
(Tel.: ASHland 4-0291)

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Two Years: C. M. ASHLEY, L. T. AVERY, L. E. SEELEY, G. D. WINANS.
One Year: J. F. COLLINS, JR., S. H. DOWNS, JAMES HOLT, E. N. MCDONNELL, T. H. URDAHL, G. L. TUVE, *Ex-Officio.*

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Meetings—James Holt, *Chairman;* L. T. Avery, A. J. Offner.
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Advisory Council

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Special Committees

Admission and Advancement: H. B. Hedges, *Chairman (one year);* C. H. B. Hotchkiss *(two years);* E. L. Crosby *(three years).*
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Constitution and By-Laws: R. H. Carpenter, *Chairman;* S. H. Downs, J. H. Walker.
F. Paul Anderson Award: A. J. Offner, *Chairman;* W. H. Carrier, F. E. Giesecke, W. L. Fleisher, F. B. Rowley.
Publication: L. E. Seeley, *Chairman (one year);* J. C. Fitts *(two years);* W. E. Heibel *(three years).*
War Service: E. O. Eastwood, *Chairman;* M. F. Blankin, W. H. Carrier, S. H. Downs, A. C. Willard.

Committee on Research

ASHVE Research Laboratory
10700 Euclid Ave., Cleveland 6, Ohio
(Tel.: RAndolph 8844)
G. L. TUVE, *Chairman*
L. P. SAUNDERS, *Vice-Chairman*
CYRIL TASKER, *Director of Research*
A. C. FIELDNER, *Ex-Officio*

Three Years: R. M. CONNER, JOHN A. GOFF, F. W. HUTCHINSON, R. K. THULMAN, W. E. ZIEBER.
Two Years: C. M. ASHLEY, F. E. GIESECKE, F. C. MCINTOSH, G. L. TUVE, T. H. URDAHL.
One Year: JOHN JAMES, H. J. ROSE, L. P. SAUNDERS, L. E. SEELEY, A. E. STACEY, JR.
Executive Committee: G. L. TUVE, *Chairman;* L. P. SAUNDERS, *Vice-Chairman;* C. M. ASHLEY, H. J. ROSE and L. E. SEELEY.

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M. F. DuChateau	L. F. Kent	ATLANTA	L. F. Kent	T. T. Tuck
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M. L. Todd	T. R. Johnson	IOWA	M. L. Todd	T. R. Johnso
R. B. Mason	D. M. Allen	KANSAS CITY	R. B. Mason	D. M. Alle
Einar Anderson	F. T. Ball	MANITOBA	Einar Anderson	William Glas
D. M. Archer	C. W. Larson	MASSACHUSETTS	C. W. Larson	D. M. Archer
W. A. Danielson		MEMPHIS		
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R. F. Wormley	Leo Garneau	MONTREAL	R. F. Wormley	Leo Garneau
Verne Simmonds	D. E. McCulley	NEBRASKA	Verne Simmonds	D. E. McCulle
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B. J. Foss	R. K. Werner	NORTH TEXAS	B. J. Foss	R. K. Werne
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F. X. Loeffler	E. T. P. Ellingson	OKLAHOMA	F. X. Loeffler	E. T. P. Ellingso
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G. B. Rodenheiser	C. F. Boester	ST. LOUIS	C. F. Boester	B. L. Evan
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Maron Kennedy	Art Theobald	SOUTHERN CALIFORNIA	Maron Kennedy	Art Theobal
E. V. Gritton	J. T. Young, Jr.	UTAH	E. V. Gritton	J. T. Young, Jr
F. A. Leser	R. S. Dill	WASHINGTON, D. C.	J. W. Markert	F. A. Lese
F. C. Warren	C. H. Pesterfield	WESTERN MICHIGAN	C. H. Pesterfield	F. C. Warre
F. A. Moesel	S. W. Strouse	WESTERN NEW YORK	S. W. Strouse	Roswell Farnha
E. W. Gifford	M. W. Bishop	WISCONSIN	M. W. Bishop	Ernest Sacket

Officers of Local Chapters

Atlanta: Organized, 1937. Headquarters, Atlanta, Ga. Meets, First Monday. President, I. B. Kagey, 611 Bona Allen Bldg., Atlanta 3. Secretary, M. F. DuChateau, Washington St. Viaduct, Atlanta 3.

Central New York: Organized, 1944. Headquarters, Syracuse, N. Y. President, C. M. Ashley, 300 S. Geddes St., Syracuse 1. Secretary, F. E. Hockensmith, 400 N. Midler Ave., Syracuse.

Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. President, J. D. Slemmons, 2 Fifteenth Ave., Columbus 1. Secretary, A. W. Williams, 5 E. Long St., Room 808, Columbus 15.

Cincinnati: Organized, 1932. Headquarters, Cincinnati, Ohio. Meets, Second Tuesday. Honorary President, Capt. C. E. Hust. President, G. V. Sutfin, 1005-6 American Bldg., Cincinnati 2. Secretary, A. W. Edwards, 626 Broadway, Rm. 307, Cincinnati 2.

Connecticut: Organized, 1940. Headquarters, New Haven, Conn. President, L. A. Teasdale, 20 Ashmun St., New Haven. Secretary, Winfield Roeder, 405 Temple St., New Haven.

Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, L. V. Cressy, 423 Baronne St., New Orleans 13. Secretary, J. S. Burke, 317 Baronne St., New Orleans 9.

Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Wednesday. President, C. L. Peterson, 2 Indian Rock Path, Berkeley. Secretary, James Gayner, 260 California St., San Francisco 11.

Illinois: Organized, 1906. Headquarters, Chicago, Ill. Meets, Second Monday. President, A. O. May, Room 925, 53 W. Jackson Blvd., Chicago 4. Secretary, C. M. Burnam, Jr., Room 1605, 6 N. Michigan Ave., Chicago 2.

Indiana: Organized, 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. President, W. C. Bevington, 730 Indiana Pythian Bldg., Indianapolis. Secretary, C. W. Stewart, 1001 York St., Indianapolis.

Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, W. W. Stuart, 417 9th St., Des Moines 9. Secretary, E. O. Olson, 414 Twelfth St., Des Moines.

Kansas City: Organized, 1917. Headquarters, Kansas City, Mo. Meets, First Monday. President, D. M. Allen, 215 Pershing Rd., Kansas City 8. Secretary, R. E. Bade, 1102 Commerce Bldg., Kansas City.

Manitoba: Organized, 1935. Headquarters, Winnipeg, Man. Meets, Third Thursday. President, Einar Anderson, 152 Bannerman Ave., Winnipeg. Secretary, F. T. Ball, 324 Main St., Winnipeg.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, D. M. Archer, 143 Federal St., Boston 10. Secretary, C. W. Larson, 184 Sycamore St., Roslindale.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, J. J. Nolan, 78 Washington Ave., Memphis. Secretary, W. E. Thorpe, 78 Washington Ave., Memphis.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, W. H. Old, 1761 Forest Ave. W., Detroit 8. Secretary, A. E. Knibb, 1003 Maryland Ave., Detroit 20.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, F. W. Legler, 17 W. 28th St., Minneapolis. Secretary, F. H. Schernbeck, 1057 10th Ave., S. E., Minneapolis.

Montreal: Organized, 1936. Headquarters, Montreal, Que. Meets, Third Monday. President, A. B. Madden, 1170 Beaver Hall Sq., Montreal, Que. Secretary, Leo Garneau, Room 832, Dominion Sq. Bldg., Montreal, Que.

Nebraska: Organized, 1940. Headquarters, Omaha, Nebr. Meets, Second Tuesday. President, B. G. Peterson, 6235 Florence Blvd., Omaha. Secretary, D. E. McCulley, 814 S. 14th St., Omaha 2.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, C. S. Koehler, 4374 Richardson Ave., New York 66. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, F. E. P. Klages, 1034 Jefferson Standard Bldg., Greensboro. Secretary, W. L. Hunken, 707 Guilford Bldg., Greensboro.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, E. T. Gessel, 610 Thomas Bldg., Dallas 1. Secretary, C. Rollins Gardner, 911 Camp St., Dallas 2.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, D. L. Taze, 1302 Swetland Bldg., Cleveland 15. Secretary, R. H. Cutting, 3795 Glenwood Rd., Cleveland Heights.

Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, E. T. P. Ellingson, 314 Savings Bldg., Oklahoma City 2. Secretary, G. T. Donceel, Oklahoma Natural Gas Co., Oklahoma City.

Ontario: Organized, 1922. Headquarters, Toronto, Ont. Meets, First Monday. President, A. S. Morgan, 156 Glenmanor Dr., Toronto, Ont. Secretary, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, F. F. Urban, 62[illegible] S. W. Burlingame Ave., Portland. Secretary, M. W. Pysher, [illegible] S. E. Sixth Ave., Portland 14.

Pacific Northwest: Organized 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, M. N. Musgrave, 2[illegible] Third Ave., Seattle 1. Secretary, J. D. Sparks, 7331 W. Green Lake Way, Seattle 3.

Philadelphia: Organized, 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, A. C. Caldwell, 550 S. 4[illegible] St., Philadelphia 43. Secretary, J. O. Kirkbride, Fourth and Locust Sts., Philadelphia 6.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, T. F. Rockwell, Carnegie Institute of Technology, Schenley Park, Pittsburgh. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, J. H. McCabe, 1730 Glenarm St., Denver. Secretary, F. L. Adams, P. O. Box 840, Denver 1.

St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, G. B. Rodenheiser, 4431 Finney Ave., St. Louis 13. Secretary, B. L. Evans, 571 Stratford Ave., University City.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, A. F. Barnes, 602 Kirby Bldg., Houston 2. Secretary, B. P. Fisher, Box 92, Houston 1.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Second Wednesday. President, Leo Hungerford, 3485 Wonderview Pl., Los Angeles 28. Secretary, Arthur Theobald, 336 North Foothill Rd., Beverly Hills.

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, H. G. Richardson, 1433 Harvard Ave., Salt Lake City. Secretary, E. V. Gritton, 2470 S. 15th East St., Salt Lake City.

Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, J. W. Markert, 8506 Garfield St., Bethesda, Md. Secretary, A. S. Gates, Jr., 11[illegible] County Rd., Kensington, Md.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, H. D. Bratt, 2259 Stafford Ave., S. W., Grand Rapids 7. Secretary, Frank Harbin, Jr., 181 West 21st St., Holland.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, S. W. Strouse, 4[illegible] Franklin St., Buffalo 2. Secretary, G. E. Adema, 39 W. Balcom St., Buffalo.

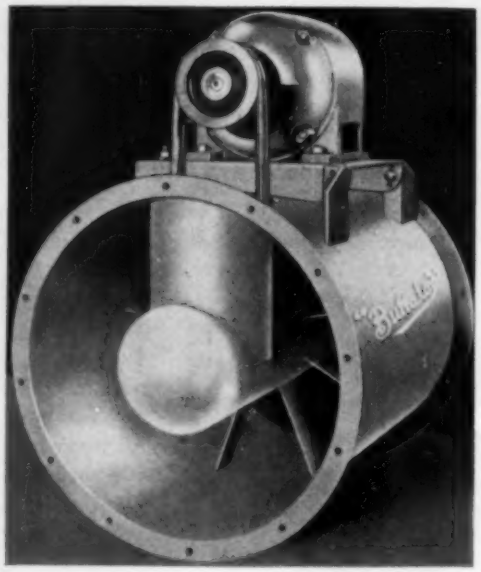
Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, I. J. Haus, 3880 N. Richards St., Milwaukee 1. Secretary, M. W. Bishop, 261 W. Wisconsin Ave., Milwaukee 3.

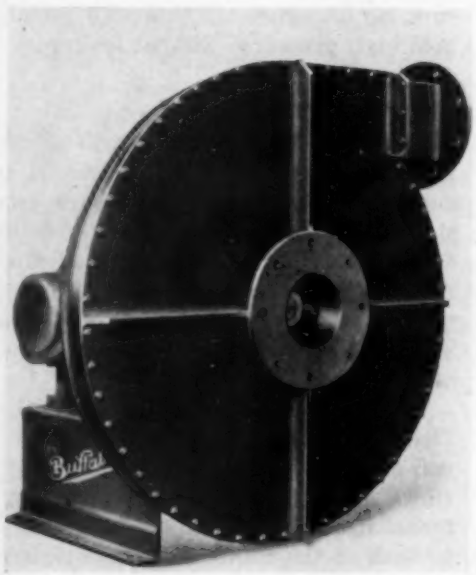
EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the names of products and companies listed here to your Directory section which you received in your January 1945 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Axial Flow Fans and Pressure Blowers

No. 2787—The "Type B", a moderately priced line of highly developed axial flow fans, is now offered for general ventilating and air conditioning service by Buffalo Forge Co., 491 Mortimer St., Buffalo, N. Y. In this fan a welded steel wheel is used with large hub and curving blade pitch to give uniform air flow over the entire blade. The large hub prevents recirculatory losses. Housings are of heavy gage welded steel and rigid motor supports permit the use of standard motors. These axial flow fans are offered in belted or direct connected models in capacities up to 45,750 cfm, and in pressures ranging up to 1½ in. static. Belted models are made in vane-axial only (with stationary directional vanes) direct connected.

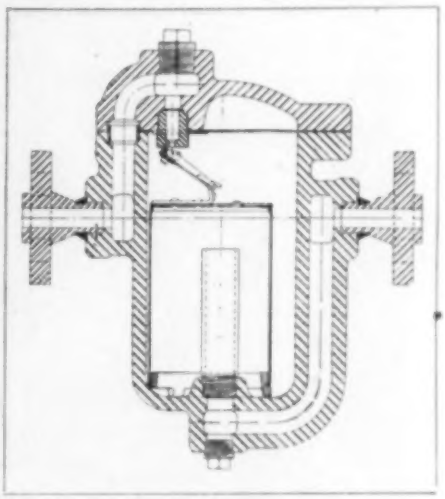




Efficiency and economy are said to be the outstanding characteristics of two new lines of pressure blowers developed by the same manufacturer. The "Type CB" (centrifugal blower) has a capacity range from 200 to 4000 cfm and a pressure range from ¾ to 2 psi. The "Type CC" (centrifugal compressor) unit ranges in capacity from 4000 to 75,000 cfm at pressures up to 4 psi.

Cast Steel Steam Trap

No. 2788—Designed for pressures up to 600 psi or where all steel fittings are desired, a new cast steel inverted bucket steam trap with side inlet, side outlet pipe connections, has been announced by the Armstrong Machine Wks., 874 Maple St., Three Rivers, Mich. It is available with ½, ¾, or 1 in. screwed or flanged connections. Flanges are welded into the trap body. Height is 11¼ in.; dimensions between flanges range from 11⅜ to 12⅛ in., depending upon pipe sizes.



The inverted bucket and valve lever are made of 18-8 stainless steel; the valve and seat are chrome steel hardened, ground, and lapped. One of the features of the trap is that the cap and interior mechanism can be removed for inspection or repair without breaking either the outlet or inlet connections. The cap and working parts are removed as a unit by unbolting the cap, leaving the body intact on the line.

Recirculating Air Heater

No. 2789—A recent development in industrial oven heating is a new recirculating indirect air heater, product of J. O. Ross Engineering Corp., 350 Madison Ave., New York 17, N. Y.

Among the construction features of this air heater are a rigid pressed steel frame which can be bolted together in as many unit assemblies as desired; flush steel casing with concealed bolts and flanges throughout; a horizontal two pass, return bend type of inter-

Heating, Piping & Air Conditioning, [4-45]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

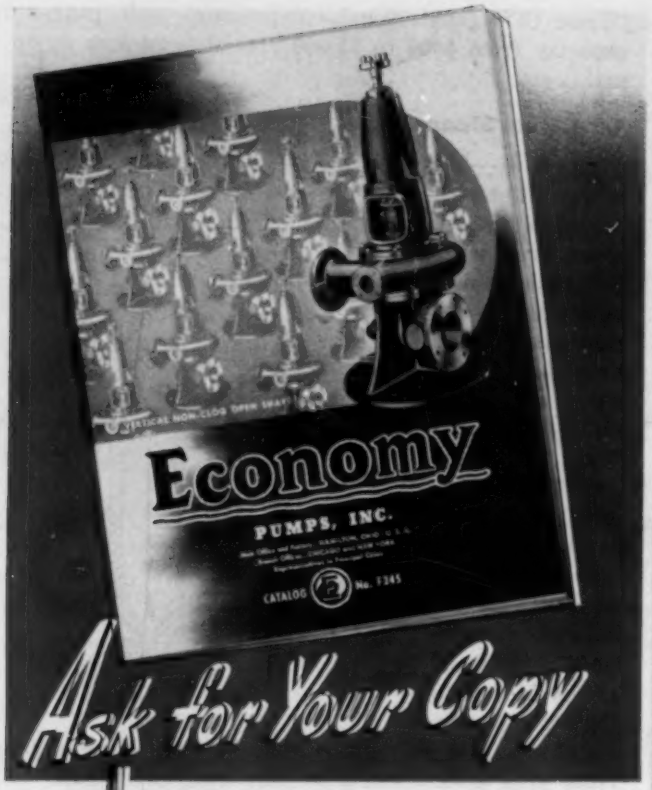
2787	2788	2789	2790	2791	2792	2793	2794	2795
2796	2797	2798	2799					
4923	4924	4925	4926	4927	4928	4929	4930	4931
4932	4933	4934	4935	4936	4937	4938	4939	4940
4941	4942	4943	4944	4945				

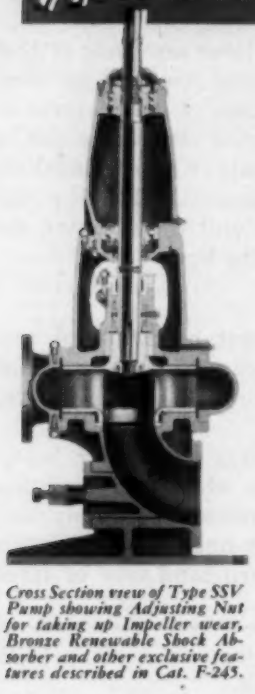
Name .....Title .....

Company .....

Address .....

City .....Zone .....State .....





Cross Section view of Type SSV Pump showing Adjusting Nut for taking up Impeller wear, Bronze Renewable Shock Absorber and other exclusive features described in Cat. F-245.

Featuring the Newest Designs . . . Complete Selection Tables of VERTICAL NON-CLOG PUMPS!

Here's your answer to the problem of pumping liquids containing solids, etc. Catalog F-245 fresh off the press presents the last word in Non-Clog construction—backed by over 30 years specialized experience, precision manufacture and modern production practice. Selection tables simplify the choice of exact types and sizes to handle your requirements. A copy of the Catalog is yours for the asking. So are the services of our engineering staff.

NOTE: There still are some valuable territories not under sales contract. Write for information on sales plan and distribution of Economy Pumps.

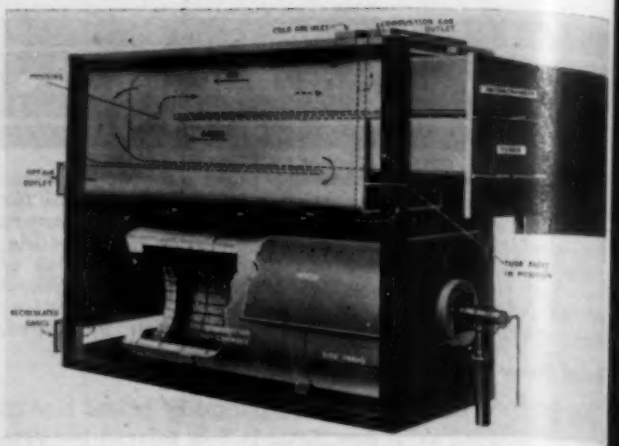
Send Economy Cat. F-245 without obligation to:

NAME..... TITLE.....

FIRM.....

ADDRESS.....

ECONOMY PUMPS, INC.
HAMILTON, OHIO



changer; a steel, air tight interchanger housing; a refractory lined combustion chamber of ample capacity; and insulated end panels which complete the assembly of each single or group heater.

This new heater so far is being built in only one outlet temperature range, 500 F to 600 F.

Stainless Steel Hose Clamps

No. 2790**—New stainless steel "Aero Seal" hose clamps designed for service where conditions require corrosion resistance are in production at the Aircraft Standard Parts Co., 1727 19th Ave., Rockford, Ill. A new mechanically interlocked saddle permits elimination of welds at that vital point.

Features of the design include worm gear drive, compact housing, no loose parts, openable band, vibration-proof holding, wide range, long take-up, uniform pressure, no distortion of thin wall tubing, and ability to hold high pressures without leakage.

Spreader Type Stoker

No. 2791—The newly introduced "J & J" spreader type stoker offers many features to increase the efficiency of combustion and assure trouble-free operation, says the manufacturer, Johnston and Jennings Co., 875 Addison Rd., Cleveland 14, Ohio. One of these features is the non-clogging and dust-tight coal feeder, adjustable for various operating conditions and designed to prevent any spillage of fines along the front of the stoker.

The three-bladed rotor receives the coal from the feeder tray and discharges it into the furnace off the end of the distributor plate, the position and slope of which are adjustable to meet the requirements of different size furnaces. A small high velocity fan mounted in back of the rotor discharges through orifices under the distributor plate, catching the fines and distributing them also to all parts of the furnace. This overcomes any tendency of the fines to drool down on to the furnace hearth, prevents segregation of fines on the front grates and lump on the rear grates.

All exposed parts of the stoker are air cooled, which avoids need for water cooling, the manufacturer says.

Here's a new way to lick leaking joints in high-pressure and high-temperature steam lines.

With Goetze Bellowseal Gaskets, line pressure itself maintains the tightness of the closure—*the higher the pressure, the tighter the joint.* For, as pressure rises, the two plates of the Bellowseal are forced apart into the packing to form perfectly leak proof joints.

You can get Bellowseals made in MONEL to meet all operating ranges and conditions. For high-temperature or corrosive service, MONEL is particularly suitable.

Use of MONEL cancels the threat of corrosion or oxidation which could make the seal inoperative through puncture or "freezing" of inside faces.

MONEL also supplies the full measure of high-temperature strength and resilience needed to withstand constant expansion and contraction. Moreover, its good welding qualities mean perfectly sound welded joints—thoroughly free from porosity—strong enough to take repeated flexing.

And from the viewpoint of the manufacturer (who has to groove the outer faces) the good machinability of MONEL is important, too.

Thus, in still *another* power plant application, MONEL is used as insurance for long life and trouble-free operation. Investigate MONEL and all the INCO Nickel Alloys whenever you need strong metals that fight heat, corrosion, wear and fatigue.

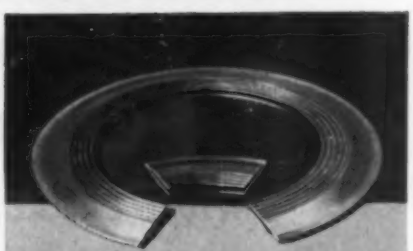
**As proved in tests using a 6" —400# A.S.A. Van Stone flange assembly with flange bolts only finger-tight. Gasket showed no leakage during cycle changes from 0 to 600 psi steam at temperatures from saturated to 850° F.*

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N.Y.

NICKEL (INCO) ALLOYS

MONEL · "K" MONEL · "S" MONEL · "R" MONEL · "KR" MONEL · INCONEL · NICKEL · "Z" NICKEL

Sheet... Strip... Rod... Tubing... Wire... Castings... Welding Rods (Gas & Electric)



The new GOETZE BELLOWSEAL GASKET

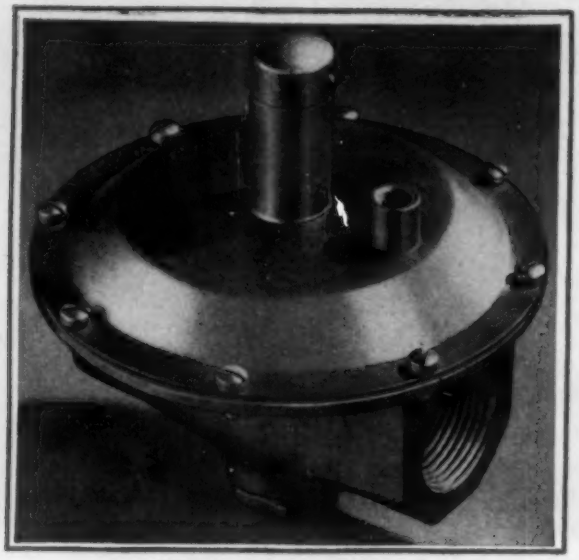
consists of 2 discs of 1/16" metal, serrated on one face and welded together around their outer periphery. When installing the Bellowseal, a ring of thin, compressed asbestos sheet packing is placed over the serrations. Then, the joint is tightened up with sufficient bolt force to cause the latter to penetrate the packing. After penetration, bolt stress can be reduced to an operating value considerably lower than that usually necessary for all-metal gaskets. The slight bevel of the inner edges of facing discs ensures penetration of the pressure *between* the discs and expansion of the gasket. Bellowseals are made by the Goetze Gasket and Packing Co., Inc., New Brunswick, N. J.

(The gasket above was tested beyond normal operating deflection to show the working principle of the new Bellowseal gasket.)

GENERAL CONTROLS

V-300

Low Pressure Gas Regulator



CHECK THESE

3 Big Advantages

V-300 *HIGH CAPACITY*

V-300 *CLOSE REGULATION*

V-300 *NOMINAL COST*

Here is a low pressure Gas Regulator that answers every requirement for a small, compact, high quality regulator that will provide high capacity and close regulation, yet be reliable and trouble-free.

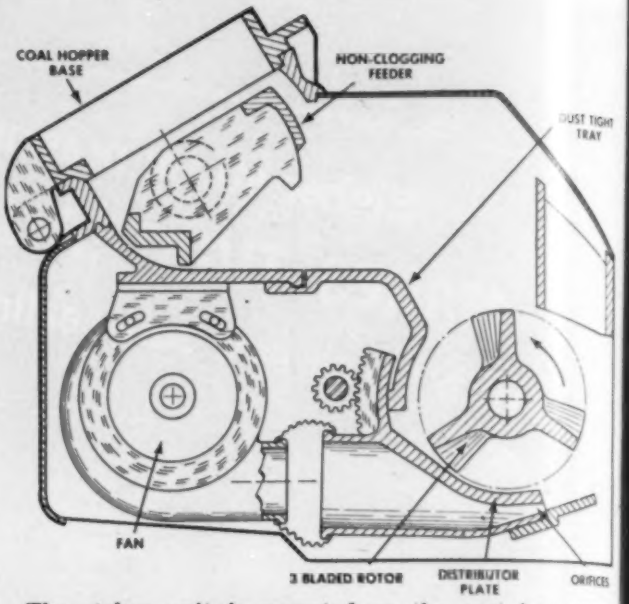
The V-300 regulator is scientifically designed to resist corrosion from all types of fuel gases, and is precision-built with the finest materials available to insure continuous and efficient appliance operation.

For complete specifications on gas regulators, solenoid valves, safety valves, fuel governors and thermostats for the Gas Industry, write for Catalog 52B or contact nearest General Controls Factory Branch or Distributor.

GENERAL CONTROLS

801 ALLEN AVENUE GLENDALE 1, CALIF.

BRANCHES: Atlanta, Cleveland, Philadelphia, Kansas City, Dallas, Boston, New York, Chicago, Detroit, Houston, Denver, San Francisco

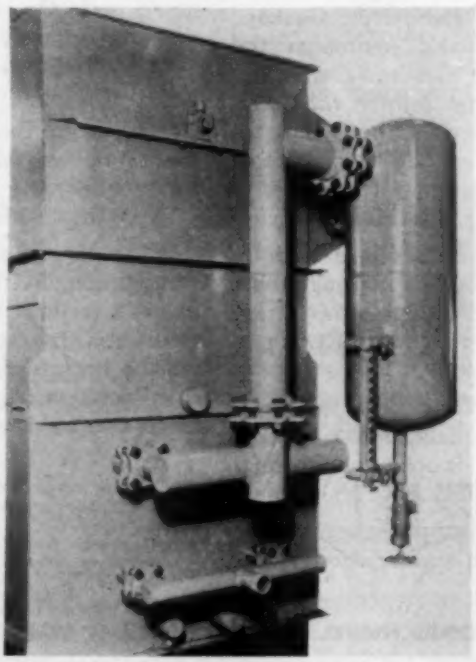


The stoker unit is mounted on the cast iron front with four hinge pins, two on each side. It is easy to remove the two pins on one side, disconnect the drive belt, and swing the entire stoker to an angle of 90 deg with the front of the furnace. This allows easy inspection and gives ample working space for adjustments.

The stokers are furnished in four standard sizes with 16, 20, 24, and 32 in. long rotors. They can be installed singly or as multiple units to meet the requirements of boilers ranging from 75 hp upward.

Removing Oil from Refrigerant

No. 2792—A new method of removing oil from refrigerant gas is offered by the Niagara Blower Co., 6 E. 45th St., New York, 17, N. Y. The new apparatus, called the "Oilout," uses a cylindrical drum at the outlet of the coil so that the refrigerant gas enters with a tangential motion. More oil is removed by this method because the "Duo-pass" coil has reduced the temperature of the gas so that the oil vapor has been condensed, says the manufacturer. Expansion of the system from a 4 in. pipe to a 14 in. drum (in the model illustrated) reduces the velocity of the gas so that the oil is easily removed and held by the wall and separator plates of the trap. A sight gage and valve for draining the oil are provided.



DEPENDABLE HEATING COUNTS!

You can Depend on CAMPBELL 8000 Series Heaters

Campbell Heaters have brought warm air heating to the highest point of reliability and efficiency. These units, modern as tomorrow in design, are produced by an organization with 65 years of experience in building large heating plants.

This background of practical experience has given the Campbell Company a thorough knowledge of the problems involved in heating large buildings. And this background has helped produce the answer to these problems—the 8000 Series Heaters.

These great Heaters are adaptable to duct or ductless installation, and will supply an abundant amount of heat at an amazingly low fuel cost. They are available for all type fuels, in capacities from 725,000 to 6,000,000 B.T.U.s per hour. Each size is *unconditionally guaranteed* to deliver its full rated capacity. Learn more about this highly efficient Heater. Write today for the free illustrated circular which gives complete information.

CAMPBELL 8000 SERIES HEATERS

CAMPBELL HEATING COMPANY

Des Moines 4, Iowa

Electric Heating Units

No. 2793—Landis & Gyr, Inc., 104 Fifth Ave., New York 11, N. Y., is now supplying electrical heating elements as completely sheathed units. The illustration shows a heater which is cylindrical for the width of 1 in. and then fans out to form a truncated cone. This particular unit contains a woven type heating element, asbestos heat lagging on top, and the assembly covered by a metal spinning. In other cases the units are furnished with "Fiberglas" covering or with bare resistance wire.

Manufacturing Facilities for Heaters

No. 2794—The WPB has given the Herman Nelson Corp., manufacturer of heating and ventilating equipment, a priority for the erection of a 51,000 sq ft addition to one of its plants in Moline, Ill. According to R. H. Nelson, president, this additional factory space is required because of large contracts recently awarded the company for the manufacture of self-powered heaters. These heaters have been extensively used during the war by the Army air forces, the quartermaster corps, and the Navy for the preheating of airplane, tank, and truck engines in cold climates and for the heating of all types of portable tents, Quonset huts, and other structures used by combat troops.

Dust Collector

No. 2795**—Manufactured in four sizes, the "Dustex" portable dust collector is designed to meet the need for an efficient and economical means of removing from the air dangerous and obnoxious dusts arising from industrial operations, such as lint, shavings, grindings, etc., says the Dust Filter Co., 4418 N. Clark St., Chicago 40, Ill.

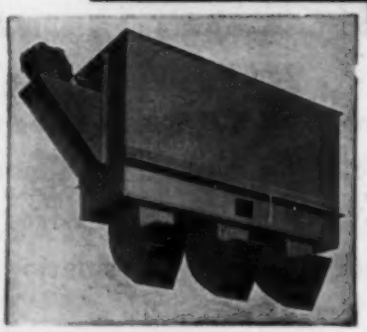
The principle underlying the unit is the compound action on the airborne dust first by centrifugal separation from the air stream and second by impingement on the filter surface. The unit maintains constant static air suction of more than 4 in. at a velocity of over 5000 lfm. Units weigh from 75 to 200 lb and are 30 in. to 51 in. high.

The filter assembly consists of two corrugated layers of wire mesh covered with 60 mesh filter cloth. Filtered air is discharged through a muffler to deaden air noise.

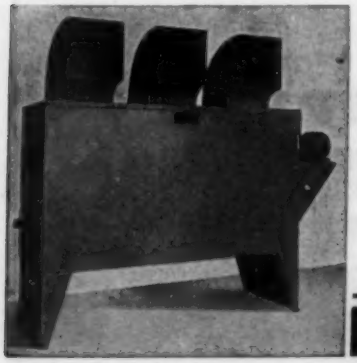
Available for Prompt Delivery—

THE AIRTHERM CENTRIFUGAL FAN TYPE, STEAM UNIT HEATER

(Vertical, Horizontal, or Floor Type Models)



Ceiling mounted, inverted type.



Floor mounted.

The Airtherm centrifugal, fan type, steam unit heater is a highly efficient heater for either vertical or horizontal suspension and is available to you for delivery during the present heating season.

This high velocity unit insures uniform temperature distribution and maximum heat flow effecting savings in both fuel and maintenance cost. Capacities range from 200,000 to 825,000 B.T.U.

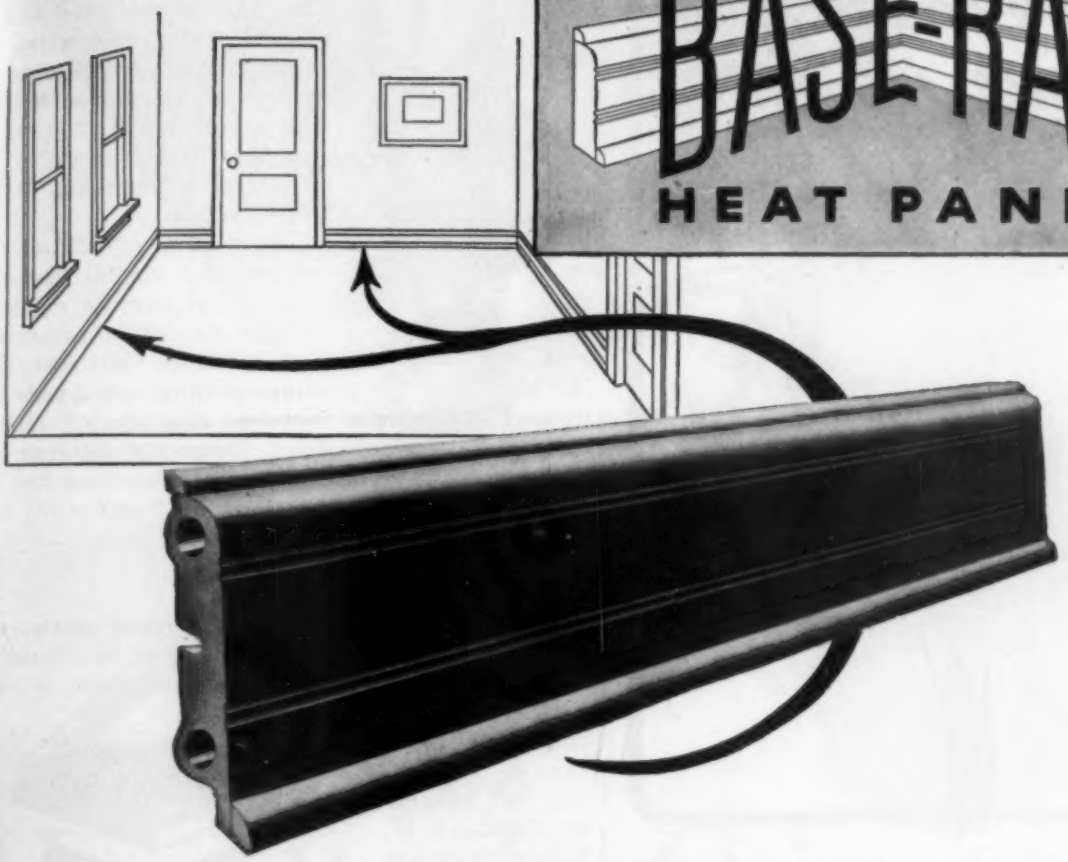
Send us your specifications or write for the Airtherm Catalog today. Our engineers will gladly work with you in planning efficient heat for your plant.

AIRTHERM MANUFACTURING COMPANY

711 South Spring Avenue • St. Louis 10, Missouri

ANNOUNCING THE SENSATIONAL NEW

BURNHAM BASE-RAY HEAT PANEL



Here's the NEWS you've been waiting for! Here's Burnham's sensational improvement in radiant heating! The illustration and diagram above tell the story. The Burnham BASE-RAY Heat Panel shown here with top and bottom moldings in place, comes in easy-to-handle sections. These sections replace the baseboard in a room and are practically as inconspicuous. A wonderful improvement over both radiators and registers—decoratively and functionally.

Burnham BASE-RAY Heat Panels are easy to install. Reasonable in price. Built for life-long, trouble-free service. Here's RADIANT HEATING at its best . . . more uniform, healthful heating . . . more economical heating, too—because with this type of installation, rooms are *actually more comfortable at lower temperatures*—and that means *fuel saved!*

Burnham is telling Home Owners about BASE-RAY through half-page advertisements in National Magazines—against the day when this new, better, more modern heating method will be available.* Make sure you are in a position to cash in on this publicity and the demand it is bound to create. Be fully informed. Write us for further facts on BASE-RAY, NOW!

**Government restrictions prevent the manufacture of BASE-RAY Heat Panels until after the war.*

Burnham Boiler Corporation

IRVINGTON, N. Y., Dept. P • ZANESVILLE, OHIO, Dept. P

Export Department
50 CHURCH ST., NEW YORK 7, N. Y.

Burnham RADIANT WARMTH SINCE 1873

I.B.R. INSTITUTE OF BOILER AND RADIATOR MANUFACTURERS MEMBER

An Efficient work-bench

Easily carried to your job

RIDGID

Portable Tristand Vise

●This roomy Tristand folds up snugly, carries easily, sets up solid anywhere you need it. Screw-down feet and ceiling brace if you want them. Lots of space for oil can and dope pot, plenty of slots to hang tools. It has a pipe rest and 3 handy pipe benders — and an efficient vise with LonGrip jaws, easy on polished pipe. Buy it for easier work— at your Supply House.

Tristand Chain Vise.

RIDGID

WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY · ELYRIA, OHIO, U. S. A.

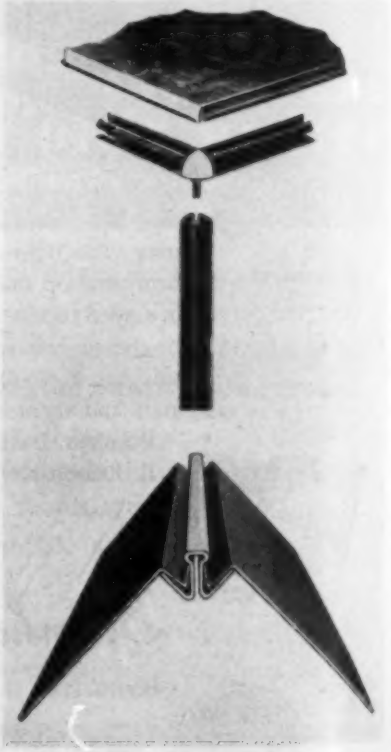
High Lift Pop Valve

No. 2796—The Farris Engineering Co., Palisades Park, N. J., has developed a pop relief valve which is said to have an exceptionally high coefficient of lift for the disc. This is secured through the unique design of the valve disc, by which the velocity of the fluid is entrapped and its kinetic force is converted into additional lift for higher relief discharge. The valves, designed for pressures up to 300 psi, are made in sizes ½ to 2½ in. and are said to meet full ASME specifications.

This valve is built with an adjustable single blowdown ring which permits regulation of the amount of pressure to be relieved on individual operations. Another new type is built without an adjustable blowdown ring which is replaced by a predetermined orifice. Primarily designed "for equipment manufacturers or others requiring low first cost and yet dependable performance," this utility valve is made in sizes ⅜ to 1 in.

Snap Assembly Construction

No. 2797—A prefabricated light metal construction, known as "Struc-Lok," based on a method of snap assembly which requires no bolts, screws, rivets, or welds, has been announced by Lindsay & Lindsay, 222 W. Adams St., Chicago 6, Ill. This construction meets the need for applications where lighter weights are requisite and strength requirements are correspondingly lower, the manufacturer says.



Fabricated in both aluminum and steel, the unit consists of only three basic parts: framing, sheets, and fittings. All parts are accurately die-formed in a wide variety of sizes. Assembly can be handled by men or women without special training, as all of the parts snap together by hand. The basic principle of the assembly is as follows: special fittings connect the framing and hold it together while the flanged edges of the sheets are snapped into die-rolled frame chan-

reducing
Installation Costs

To reduce pipe installation costs and time, you need a pipe that's easy to cut and thread. Beth-Co-Weld is just the pipe for the job.

Beth-Co-Weld is made of tough, ductile steel on modern high-speed mills. It's a dependable pipe for all kinds of circulation systems. Beth-Co-Weld's uniform characteristics and strong weld make it the ideal pipe for rugged service and handling.

Use Beth-Co-Weld on your next plumbing and heating job. Made in all sizes up to and including 3 inches, in uniform 21-foot lengths, plus or minus 1 inch; black and galvanized; and standard-weight and extra-strong.

BETH-CO-WELD PIPE

PETRO
REG. U.S. PAT. OFF.

OIL BURNING SYSTEMS

Petro Class A (Industrial) Equipment is currently available under W.P.B. regulations and ratings.

Petro equipment includes:

DOMESTIC "CONVERSION" BURNERS
1 to 6 gal. per hour

LARGER "LIGHT (No. 3) OIL" BURNERS
general application type
6 to 18 gal. oil per hour

COMBINATION BURNER-GENERATOR UNITS
both steel and C. I. sectional boilers; forced warm air units; and instantaneous water heaters.

INDUSTRIAL OIL BURNERS
Manual - Semi Auto - and Automatic* for either un-heated or pre-heated industrial oils, up to 145 g.p.h. Built-in motor or belt drive.

*When pre-heated oils are burned the Petro Thermal Viscosity system insures consistent maximum combustion efficiency at all firing stages, automatically and reliably.

Petro Engineering co-operation is still available. Research-development is active. When your post-war activities start, Petro will be ready for you.

OIL IS AMMUNITION
USE IT WISELY

Full data on Petro Industrial Burners are in our Catalog—see Sweet's or Domestic Engineering Catalog Files — or we will gladly send copies on request.

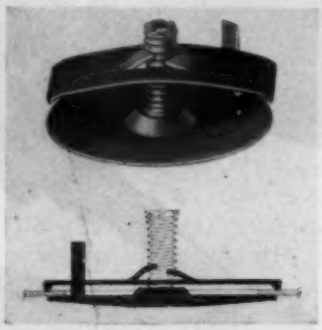
PETROLEUM HEAT AND POWER COMPANY
Makers of Good Oil Burning Equipment Since 1903
STAMFORD CONNECTICUT

nels. As the edges of the sheets snap into place they lock the framing and sheets into position, providing a lightweight unit with no space used for reinforcing braces.

Some of the uses include light machinery housings, cabinets for electrical and electronic equipment, refrigerators, walkin coolers, sharp freeze units, furnace casings, kitchen cabinets, air conditioning units, shipping containers, storage bins, shelving, and radiator covers.

Cover Plates

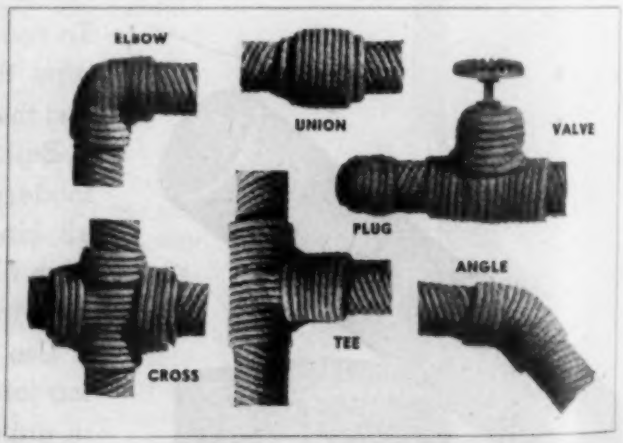
No. 2798—New speed nut cover plates were first designed for patching bullet holes in airplanes; now their industrial applications include removable covers for inspection doors, access holes, and vent holes. They are also used to seal up holes left after alterations or removal of equipment. They are easily and quickly attached from one side, the manufacturer says, by sliding one end of the speed nut into the hole, centering the cover plate over the hole, and tightening the screw. The turned-down tab on the cover plate prevents the speed nut from turning while the screw is tightened.



Three sizes are available to fit a wide range of panel thicknesses and to cover holes 29/32, 1⅛, and 1⅜ in. in diameter. Other sizes are made on special order. Manufactured by Tinnerman Products, Inc., 2018 Fulton Rd., Cleveland 13, O.

Prevents Drip from Pipes

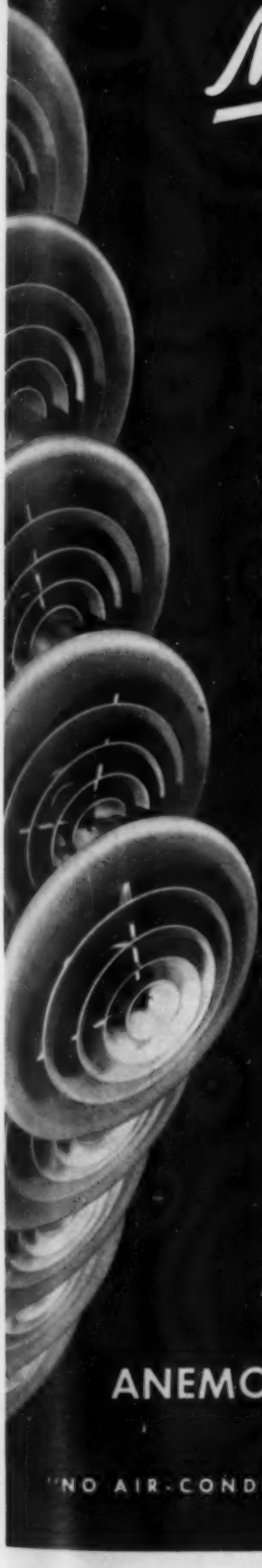
No. 2799—A pliable, cork-filled tape, the "No-Drip" immediately stops damaging drip from cold water pipes, says the manufacturer, J. W. Mortell Co., Kankakee, Ill.



The tape forms a snug, sealed jacket around pipes, is applied without tools, and completely covers fittings, valves, etc. It is said to be ideal for pipes 1 in. in diameter and smaller.

* * * * *

BUY AN EXTRA WAR BOND



More Anemostats Provide Draftless Air Distribution in War Production Plants than All Other Types of Ceiling Air Diffusers Combined . . .

The satisfaction of the users and specifying engineers is attested by a multitude of repeat orders.

Huge Anemostats handle the desired volume of air for heating in winter and cooling in summer, at duct speeds of over 30 miles per hour — yet there is no draft condition in the breathing zone. Then Anemostats serve Instrument Rooms where a temperature variation of not more than plus-minus ½° is permissible. Any conditions can be met with the Anemostat!
Consult us on special applications.

Partial List of Installations

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Allis Chalmers Mfg. Co.
Allison Engineering Corporation
Aluminum Co. of America
American Blower Co.
American Bosch Corp.
American Cyanamid Co.
Bausch & Lomb
Bell Aircraft Corp.
Bendix Aviation Corp.
Bethlehem Steel Co.
Blaw Knox Co.
Boeing Aircraft Co.
Briggs Manufacturing Co.
Buick Motor Corp.
Carter Carburetor Co.
Cessna Aircraft Co.
Chain Belt Co.
Champion Spark Plug Co.
Chevrolet Aircraft Corp.
Chrysler Corp.
Columbia Steel Co.
Cramp Shipbuilding Co.
Crosley Corporation
Curtiss Wright Co.
Cutler Hammer Inc.
Defense Plant Corp.
Delco Appliance Div.
Douglas Aircraft Co.
E. I. duPont de Nemours
Eastern Aircraft Corp.
Eastman Kodak Co.
Fairchild Aircraft Co.
Ford Motor Co.
General Electric Co.
Goodyear Aircraft Corp.
Grumman Aircraft Eng. Corp.
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Johnson and Johnson
Jones & Laughlin Steel Corp.
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New York Shipbuilding Corp.
North American Aviation Inc.
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Norton Company
Packard Motor Co.
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Republic Aviation Corp.
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"NO AIR-CONDITIONING SYSTEM IS BETTER THAN ITS AIR DISTRIBUTION"

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 159. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending in your request to Heating, Piping & Air Conditioning.

Air Conditioning

No. 4923—The March issue of Weather Magic, house organ of the Trane Co., La Crosse, Wis., is a special edition which traces the development of the science of air conditioning, and tells how the company has designed products to meet specific needs of the industry.

Ammonia Removal from Boiler Feedwater

No. 4924—The Cochrane Corp., 3131 N. 17th St., Philadelphia 32, Pa., has issued a 4 page reprint (39) which discusses briefly the removal of ammonia from boiler feedwater. This discussion takes into account three practical methods: the use of a deammoniator; the use of chlorine; and the use of an acid-regenerated zeolite.

Centering Head

No. 4925—The "Boyce" centering head can be used to measure any angle or bend of the inside or outside of a circumference, as well as the degree of declivity of any flat surface. It is described in a letter from the Eastern Research & Engineering Co., 37 Pearl St., Boston 10, Mass.

Centrifugal Pumps

No. 4926—A 32 page bulletin (80) of Pacific Pumps, Inc., 5716 Bicket St., Huntington Park, Calif., describes the manufacturer's complete line of pumps for many purposes—oil well, pipe line, refinery, hot oil, and boiler feed service, as well as pumps for synthetic rubber plants and for municipal and industrial service.

Double Suction Pumps

No. 4927—A 20 page bulletin on double suction general purpose pumps, with information on construction details and performance of large and small capacity pumps for moderate heads, has been issued by Economy Pumps, Inc., 1000 Weller Ave., Hamilton, Ohio.

Electronic Resistance Thermometer

No. 4928—A 12 page bulletin (230-A) describing "Pyroton" electronic resistance thermometers in indicating, recording, and controlling models for temperatures between minus 100 F and plus 1200 F has recently been published by the Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio.

Flexible Couplings

No. 4929—The principle of operation and the construction features of flexible couplings, as well as engineering data and dimensions of several different types of couplings for a variety of applications, are presented in a 24 page catalog published by the Ajax Flexible Coupling Co., Inc., Westfield, N. Y.

Flexible Metal Hose

No. 4930—A new engineering data file on the in-

When Your Iron and Steel Products Require HOT DIP GALVANIZING, Let 'the Nation's largest' Do It!

Your iron and steel products deserve the lasting protection against rust and corrosion that is guaranteed by the process of PENNizing . . . the Quality process of Hot Dip Galvanizing. Experience has proved that Hot Dip Galvanizing will assure greater protection and better service . . . you can be SURE of this when you use the PENNizing process . . . perfected by the Penn Galvanizing Company since 1910.

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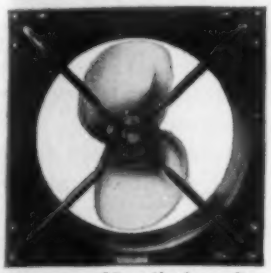
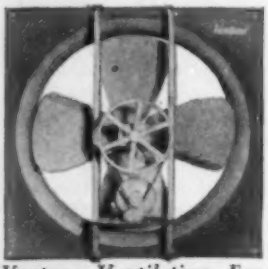
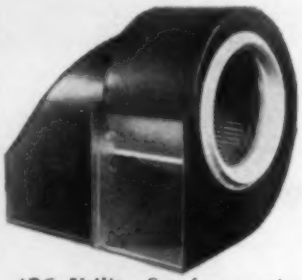
AMERICAN BLOWER



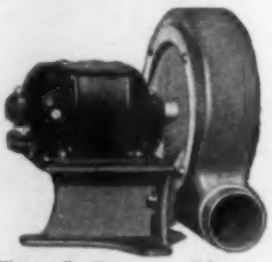
Ventura Ventilating Fan with direct connected 2-speed fully enclosed motor.



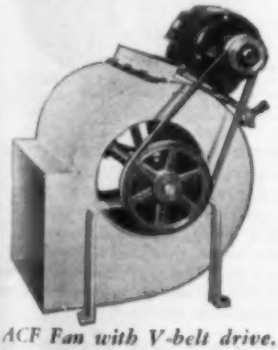
Ventura Ventilating Fan with V-belt drive.



ABC Utility Set for ventilating with a duct system.



Type P Pressure Blowers.



ACF Fan with V-belt drive.

Other fans to meet every air handling need.

"There," he said, "is where it belongs!"

"I FEEL so good about our new Ventilating System," writes a nationally known manufacturer, "I wouldn't hesitate to recommend American Blower equipment to anyone.

"THE CONTRACTOR who installed it did a swell job, too. When a man does a thorough job these days, you ought to put his picture in the museum along with the old masters.

"THERE is where it belongs. I feel like placing our contractor's picture there myself."

TIP-OFF—You can get a swell job on any problem of ventilating, air handling and exhausting from your local Ventilating Contractor or Dealer.

AND YOU will be sure of getting complete satisfaction if you ask for American Blower Equipment.

AMERICAN BLOWER

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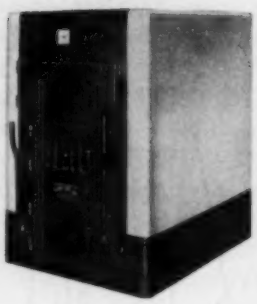
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

Top acceptance from men who know



NO. 3 SERIES HEAT EXTRACTOR BOILER*

Heating Contractors — men who specify, sell and install — know boilers. They have told us that the NRC No. 3 Series Heat Extractor Boiler is the best they have ever handled. It's easy to set up . . . attractive . . . exceptionally well designed heating surface . . . performs with economical dependability.

It is the ONE boiler which was designed for convertibility to any fuel—without loss of rating. Hand or mechanically fired, the same rating is obtained, no penalties for postwar fuel conversion.

I=B=R Ratings 700 sq. ft. to 2300 sq. ft. steam.

Install the NRC No. 3 Series on your next job . . . you too will be sold that it is TOPS in modern boilers.

*Furnished with jacket when WPB permits.

The NATIONAL RADIATOR Co.

229-4 Central Avenue • Johnstown, Pa.

OVER 50 YEARS OF SERVICE TO THE HEATING INDUSTRY

stallation of flexible metal hose has just been issued by Packless Metal Products Corp., 31 Winthrop Ave., New Rochelle, N. Y. There are over 60 pages of photographs, specifications, and line drawings. The drawings have been developed from the experience of field engineers and show the correct installation practices for getting maximum serviceability out of hose.

Sections are devoted to showing how to assemble detachable, self sealing, hose couplings and self flaring fittings for copper and plastic tubing at the job. The manufacturer's line of hose constructions, as well as flange and coupling types, vibration absorbers, laundry and platen press units, and other specialties are illustrated and described.

Fluid Flow Measurement

No. 4931—A 16 page catalog (R-100A) issued by the Cochrane Corp., 3131 N. 17th St., Philadelphia 32, Pa., contains helpful data on the selection of a "Rotameter" for measuring fluid flow on any particular service. Specific gravities of gases and of various metals used in floats are given, together with formulas for converting water and air capacities to terms of other liquids and gases. Other selection factors such as pressure drop, length of scale, and float material are covered.

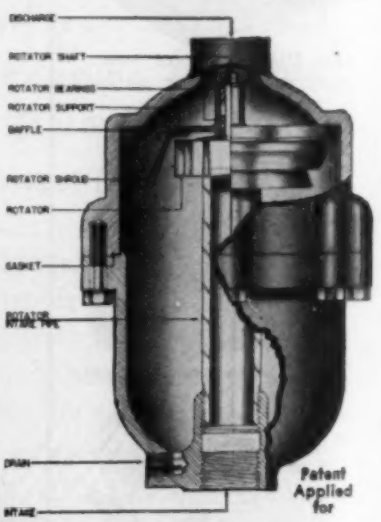
Hot Water Heating

No. 4932—A 4 page folder describes the "Comfort Package" for hot water heating, manufactured by Hoffman Specialty Co., 1001 York St., Indianapolis 7, Ind. The "package" includes a circulator, thermostat, control valve, and control panel.

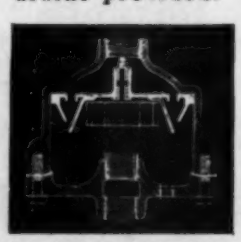
NEW TURBO-ROTOR *Pur-O-fier*

For Compressed Air

This new unit effectively eliminates moisture, oil and scale from compressed air lines. Pur-O-fier utilizes the principle of centrifugal force to separate entrainments from purified air. Once installed it requires absolutely no maintenance. Penstar Tru-Bond oiless bearing guarantees long, trouble-free operation. Manual or automatic drains provided.



Patent Applied for



Drawing shows turbo-rotor, shroud and baffles. The design of the baffles precludes the possibility of capillary action of entrainments resulting from high velocity.

THREE MODELS AVAILABLE—A-1 will accommodate volumes from ½ to 5 cu. ft. A-2, volumes from 10 to 35 cu. ft. A-4, volumes from 35 to 100 cu. ft. Multiple units are recommended for volumes above this range. Pur-O-fier is the only standard unit that can be engineered to meet any air volume for regular or intermittent service.

BIRD-WHITE COMPANY
3120 West Lake Street, Chicago, Illinois
Dept H.P.

THE CORRECT VALVE FOR THE JOB

Within the confines of the Jarecki plant, engineering and manufacturing processes combine to produce, under one control, and with one responsibility, The Correct Valve for The Job . . . 92 years of experience in designing and manufacturing valves and fittings to meet specific requirements have proven that piping troubles can be eliminated on the drawing board, in the laboratory, and in the manufacturing plant . . .

Progressive analysis of construction demands and industrial piping requirements year by year, has enabled Jarecki engineers to anticipate your valve and fitting problems . . . to offer material solution in advance of your need . . . to give you The Correct Valve for The Job. Jarecki facilities are available to you . . . we believe you can profit by their use.

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Since 1852

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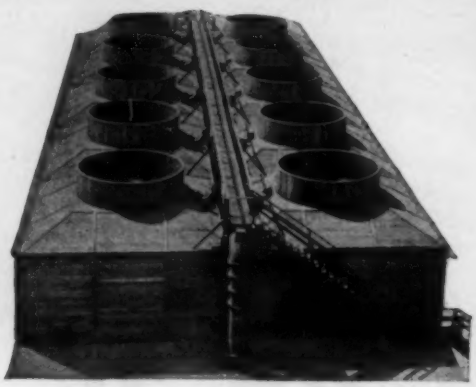
Valves and Fittings



FACTS OF L-H INDUCED DRAFT COOLING TOWERS

Air is drawn through louvred openings at base; passes upward through eliminators; then out fan throat at top.

As air flows upward, it mixes with descending drops of water; reaches the top in a saturated condition; then is discharged into the atmosphere.

A high wood stack above fan eliminates recirculation of air.

REASONS FOR TREND TO THIS TYPE

(1) Less ground space. (2) Less affected by freezing weather conditions. (3) Less fan noise. (4) Greater adaptability to modern design.

GENERAL DATA

New type removable filling gives uniform distribution of water and air over entire effective area of tower. Built in either single or multiple cells; can be arranged with all cells-in-line, or back-to-back construction.

➡ Write for: Catalog 440-A

Lilie-Hoffmann
COOLING TOWERS, INC.
Manufacturers of All Types of Water Cooling Towers
GENERAL OFFICE: 4239 DUNCAN AVE., ST. LOUIS 10, MO.
PLANTS AT ST LOUIS MO AND PLAINVIEW, TEXAS.

Insulating Varnishes and Resins

No. 4933—A 6 page booklet describes "Silicone" varnishes and resins, new forms of electrical insulation which are heat and moisture resistant and which are made by the Dow Corning Corp., P. O. Box 592, Midland, Mich.

Motor Driven Vent Sets

No. 4934—A new 12 page bulletin (3499) on motor driven vent sets has been issued by the Buffalo Forge Co., 171 Mortimer St., Buffalo, N. Y.; it gives physical data, dimensions, and ratings on "Limit-Load" belt driven fans, on cast iron "Baby" vent sets, on direct connected fans, and on "Shortboy" units in capacities up to 20,700 cfm.

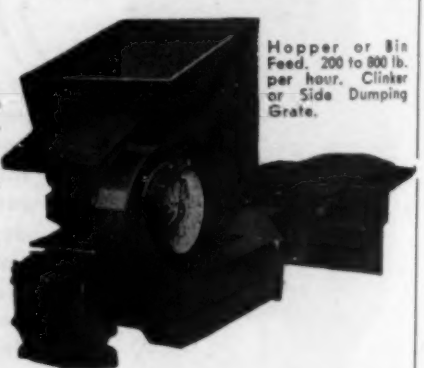
Motor Selector Guide

No. 4935—A 16 page booklet issued by the Dumore Co., Racine, Wis., provides a step by step method for selecting the correct type and size of fractional horsepower motor for any application. The data are presented in highly illustrated, outline style. The booklet describes the comparative characteristics of the various types of motors and explains many builtin controls which are desirable for certain applications.

Open Feedwater Heaters

No. 4936—The Cochrane Corp., 3131 N. 17th St., Philadelphia 32, Pa., has issued an illustrated publication (4091) which discusses open feedwater heaters of various types.

3 REASONS WHY
THE *IMPROVED* FREDERICK STOKER
SAVES FUEL . . . SAVES TIME . . . SAVES MONEY



1 The fully active grate surface. . . .
2 Continuous speed type transmission. . . .
3 Completely enclosed windboxes and mechanism.

Send for our stoker catalog . . . today. Find out about Frederick engineered features which give maximum combustion efficiency with minimum service and maintenance . . . and result in lowered fuel consumption.

Remember Frederick . . . when in the market for Centrifugal Pumps. For over 25 years Frederick has been designing and manufacturing pumps for efficient service in your industry . . . guaranteed to meet the operating conditions for which they are sold. Engineering consultation available without obligation.

THE Frederick IRON & STEEL CO.
Frederick, Maryland
STOKER SPECIALISTS SINCE 1918

VEELOS Service Report

Installation: Graphic Arts Electro and Matrix Company, Chicago

Drive: Fan

Length of Service: 8 years

Operating Time: 63 hours per week

Belts Shortened: NEVER!

Motor Re-set: NEVER!

Present Service: Excellent

The record speaks for itself. The reasons behind the record will be found in free, 8-page, illustrated Veelos manual giving Veelos applications, installation directions and engineering data. Write for your copy today.

MANHEIM MANUFACTURING & BELTING CO.
MANHEIM, PENNSYLVANIA

VEELOS
THE LINK
V-BELT
ADJUSTABLE TO ANY LENGTH
ADAPTABLE TO ANY DRIVE

THERMOSWITCHES

. . . put tires in trim for extra mileage

Vulcanizing is playing a vital part in the conservation of precious rubber . . . and in controlling the temperature of tire vulcanizers, THERMOSWITCHES give unparalleled performance.

Write for catalogue and complete information . . . to

Fenwal INCORPORATED ASHLAND • MASS.

Plastic Fan Blades

No. 4937—A single catalog sheet describes three types of propeller type, plastic fan blades made by the Burden Fan and Blower Co., 8619 W. Third St., Los Angeles 36, Calif.

Propeller Fans

No. 4938—A new 16 page bulletin (2301) of the Herman Nelson Corp., 1824 Third Ave., Moline, Ill., is devoted to propeller fans for industrial, commercial, and public buildings. In addition to capacity, dimensional, and price data, there is information on fan design and construction, and selection and application.

Radiant Heating

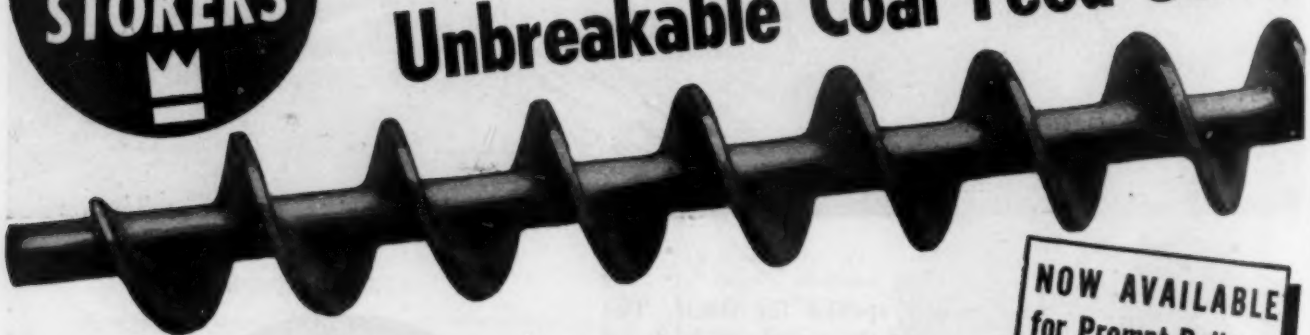
No. 4939—A 4 page pamphlet on problems of heat generation in panel or radiant heating, published by the H. B. Smith Co., Inc., 57 Main, Westfield, Mass., illustrates an installation and describes control of the oil burner and the heating system.

Radiant Heating Systems

No. 4940—How to calculate, design, and install radiant heating systems for many types of buildings is described in a new 52 page handbook just issued by A. M. Byers Co., Clark Bldg., Pittsburgh 22, Pa. Detailed procedure is listed for figuring heat losses and piping requirements, and for designing the coils and supply and return mains. Factual data are presented on the relative merits of locating the coils in the floor and ceiling. Included is a full page drawing of a floor-

For **STOKERS**

The CROWN Unbreakable Coal Feed Screw



NOW AVAILABLE for Prompt Delivery

WELDED All-Steel Worm—All Sizes—All Pitches

★ For replacement or production needs, Crown is now able to offer for prompt delivery its all-steel Coal Feed Screw. Available with right or left hand screw, in all sizes and pitches, tapered or straight, and in combinations of pitches. For both domestic and industrial stokers, the Crown Coal Feed Screw insures longer and continuous operation because it is all-steel and because it is machined so smoothly that wear is reduced to a minimum. This smooth surface is your assurance, too, that coal will flow freely and easily through the flights. Prompt delivery is possible because production requires less time on Crown's automatic machines and because the steel used in Crown's Coal Feed Screw while critical, is more easily procured.

In ordering give complete specifications on size and design.

CROWN IRON WORKS COMPANY

1202 Tyler St., N. E. — *Since 1878* — Minneapolis, Minn.

50,000 to 10,000,000 B.t.u. with WECO-N.G.E. Series F600

GAS BURNERS. For use in heating heating boilers, power boilers—in any metal firebox or sectional boiler.

Adaptable to any firebox shape or size.

Handles various gas pressures and effects low draft loss.

The Series F600 Burner operates on straight natural gas and mixed gas to 800 B.t.u. Gives perfect horizontal distribution. Full automatic controls—that operate properly —can be easily applied.

THE WEBSTER ENGINEERING CO.

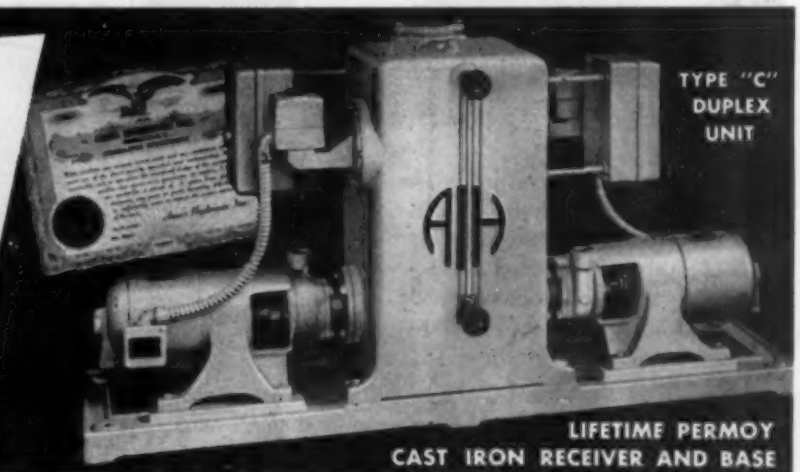
TULSA —DIVISION OF— **OKLAHOMA**

Surface Combustion . . . . . Toledo, Ohio

AMES

HYDROVAC

CONDENSATE RETURN UNITS



TYPE "C" DUPLEX UNIT

LIFETIME PERMOY CAST IRON RECEIVER AND BASE

SUPERIORITY GUARANTEED!

Engineering skill of the highest order combined with metals and other materials of topnotch quality account for the unusual 3-year Wear-Proof guarantee that goes with HYDROVAC UNITS. Note, too, these special features.

- **MOTOR VENTILATION** Pat. Applied for
- **SPECIAL MOISTURE-RESISTING VARNISH ON WINDINGS**
- **EXTRA LARGE SHIELDED BEARINGS**
- **LARGE PACKING SPACE**
- **HYDRAULIC BALANCE REDUCES THRUST**
- **NEOPRENE WATER SLINGER**

PUMPS BY WORTHINGTON

Superior in Every Way

(1) High Efficiency. (2) Beauty of Design. (3) Lifelong Durability. (4) Negligible Maintenance Cost.

Write for Bulletin No. 200-A showing Consultants' Specification Form, Standard Ratings and Blueprint

Also ask for Bulletin No. 100-A on complete line of HYDROVAC VACUUM RETURN UNITS

AMES HYDROVAC INC.

290 SCHOLES STREET

BROOKLYN 6, N. Y.

THERE's no spongy structure in Rock Cork to absorb vapor. So the original low conductivity and resulting high insulating efficiency are not affected by the presence of moisture. This advantage of Rock Cork is due to its basic composition of mineral wool combined with an asphaltic, waterproof binder.

Many Rock Cork installations are giving highly efficient service after more than 35 years. Consider, also, these Rock Cork features:

Extremely low conductivity . . . No odor absorption . . . Immunity to mold and rot . . . Resistance to termites, vermin . . . No embrittlement . . . Less shrinkage than steel . . . Easy to work and apply . . . Made in sheet and pipe covering form.

For more information, write for bulletin DS-555. Address: Johns-Manville, 22 East 40th Street, New York 16, N. Y.

JM PRODUCTS

Johns-Manville ROCK CORK

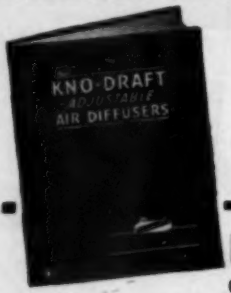
type system for a representative structure in which both sinuous coils and grids are used to advantage. The book records in picture and text 23 typical installations covering a wide range of structures. In addition to chapters on the theory, history, and achievement of radiant heating in more than a thousand installations now functioning in the United States, the handbook devotes 12 pages to answering the 34 questions most frequently asked by technical men during the past seven years.

Regulators

No. 4941—In catalog No. 50 the Locke Regulator Co., 76 North St., Salem, Mass., describes a new line of regulators. The 72 page book is divided in seven parts: hydraulic regulators for controlling fuel and air supply to boiler furnaces; combination pressure regulators for controlling the flow of steam, air, gas, water, or oil; balanced valves and self contained automatic pressure reducing regulators; pump governors; tank and float valves; temperature regulators; and engine and turbine stop equipment. This line is designed to include all flow control apparatus needed in power, heat, and process work. For special equipment the manufacturer is prepared to build apparatus to specification.

Return Traps

No. 4942—A 4 page pamphlet recently issued by Templeton Bros., Inc., 699 Main St., Walpole, Mass., describes return traps for pumping and boiler feeding, draining heaters and vacuum lines, and creating vacuum on low pressure return lines. Capacities are shown and operation is described.



NEW HANDBOOK
SIMPLIFIES SELECTION AND APPLICATION OF AIR DIFFUSERS

FREE: To those responsible for air diffusion "design."

And to those who install the equipment and are responsible for its performance.

FREE: New Engineering Data on the art of Air Diffusion in general and the proper application of KNO-DRAFT *ADJUSTABLE* DIFFUSERS in particular.

Performance Data
Selection Charts
Air Capacity Tables with instruction sheets
Damper Setting Chart
Air Direction Adjustment Chart
Standard Specifications
Complete Price List

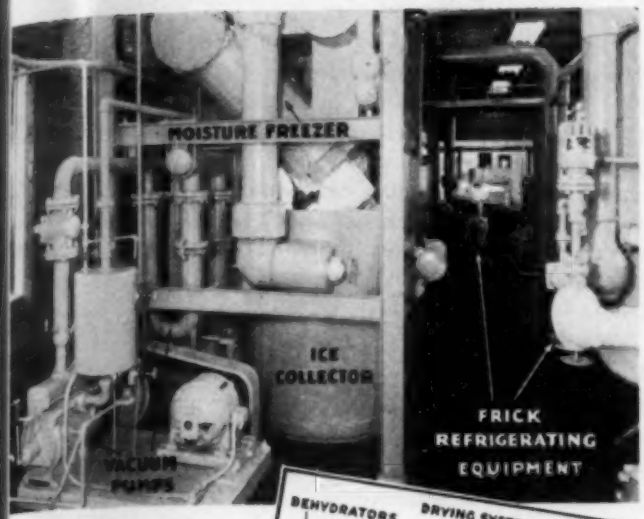
IT CONTAINS clear sketches, charts, dimension prints and instructive text for quick, accurate SELECTION – APPLICATION – LOCATION – ASSEMBLY – ERECTION – TESTING – ADJUSTMENT of air diffusers and of ACCESSORY EQUIPMENT such as dampers, air equalizing grids, mounting rings and air sectorizing baffles.

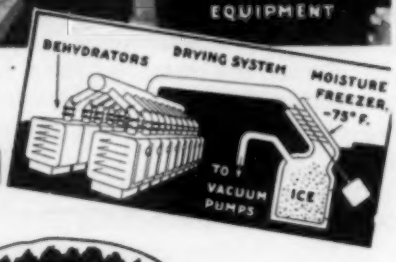
All set up in durable loose-leaf binder to facilitate the insertion of supplementary or revised data which will be forwarded from time to time to those who have sent for this catalog. Write for your free copy to Department D-2.

W. B. CONNOR ENGINEERING CORP.

114 E. 32nd Street **New York 16, N. Y.**

W.B. CONNOR



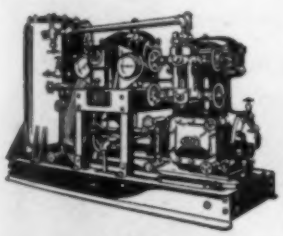


Drying Penicillin with

TRADE FRICK MARK

Refrigeration

In the $1,750,000 plant of the Commercial Solvents Corporation at Terre Haute, Ind., penicillin is dried to the nth degree by the new vacuum diffusion process. This method, developed by the National Research Corporation combines the highest vacuum ever applied to commercial drying work (one hundred-thousandth of an atmosphere) with very low temperatures (down to minus 75 deg. F.), which are maintained with Frick 2-stage Refrigeration. The striking success of this and other installations for making penicillin brought an order from our Russian Allies for four similar Frick plants for drying blood plasma.



Two Frick Combined Ammonia Units and Two Frick Booster Compressors Carry the Low-Temperature Load at the Terre Haute Plant.

Before you buy any commercial refrigerating, ice-making or air conditioning equipment, get in touch with your Frick Branch or Distributor. Write now for literature and estimates.

DEPENDABLE REFRIGERATION SINCE 1882

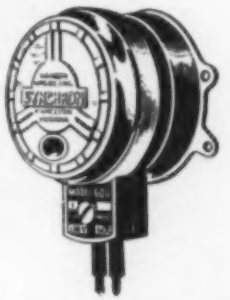
FRICK CO.

WAYNESBORO, PENNA. U.S.A.

POWER

— without "wobblies!"

SYNCHRONOUS



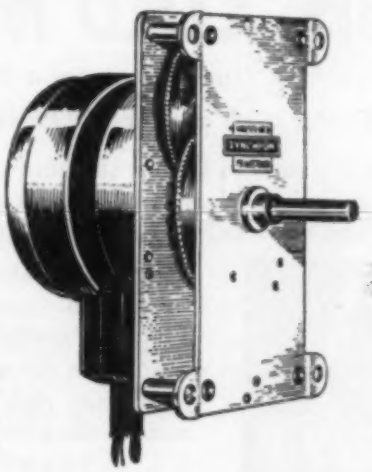
2-3/4" x 1-5/16"

Power to pull 8 oz. direct load *continuously* at 1RPM. Full capacity power—*instantly*—with no lag, no fatigue, no "wobblies" throughout its long life of carefree service. That's what you get in this proven line of time tested

SYNCHRON

TIMING MOTORS & TIME MACHINES

SELF-STARTING, SELF-LUBRICATING



INTERVALS: 1RPM, 1RPH, 1RP12H, 1RPD

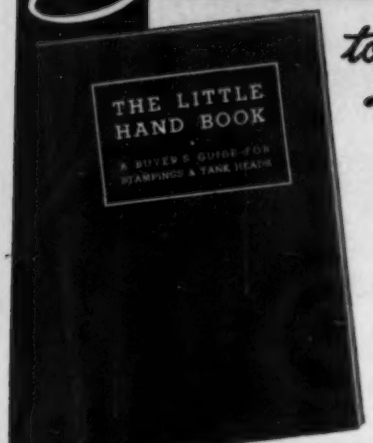
SYNCHRON Timing Machines are built around the SYNCHRON Motor. They are small, sturdy, geared to your exact requirements, and easily adapted to the compact design of time recorders, time switches, or any type of timing device. If you are interested in complete information, write today for our new catalog of facts. Our engineers will be glad to work with you on post-war production plans.

HANSEN MANUFACTURING CO., INC.

Princeton 6, Indiana

Something "NEW" has been added—

to our line of Literature!



THE LITTLE HANDBOOK NUMBER TWO

It explains how to buy tank heads and steel shapes. It will save you time and money in wires and telephone calls. The "Little Handbook" gives you the information you need. It tells about our tank heads, shapes and stampings.

Send for it.

THE COMMERCIAL SHEARING AND STAMPING COMPANY.
YOUNGSTOWN · OHIO · U.S.A.

Tubular Dust Collector

No. 4943—A 12 page illustrated bulletin describes a compact, light weight air cleaner, the "Aerotec Tube." This tube operates on the principal of continuous dust discharge and "is particularly suited to internal combustion engines, compressors, etc., where the intake air contains abrasives which cause excessive wear." There is no pressure build-up as the dust is discharged to a storage receptacle when precipitated, says the manufacturer, the Thermix Engineering Co., Greenwich, Conn.

Water Heaters

No. 4944—A 4 page catalog (TW-95D) describing "Tabasco" steel water heaters has been issued by the Kewanee Boiler Corp., Franklin St. and the "Q" Tracks, Kewanee, Ill.; specifications, dimensions, and features are given. The same company has also published a new leaflet (GW-95a) on all-welded water heating garbage burners rated to heat 165 to 700 gph of water 50 F.

Welding for Maintenance

No. 4945—A 6 page bulletin on low temperature welding rods, concentrating on the problems which concern maintenance, has been issued by the Eutectic Welding Alloys Co., 40 Worth St., New York 13, N. Y. The process in which these rods are applied at low temperatures to cast iron, steel, aluminum, bronze, etc., is described.

FRESH, COLD MILK for the SHIPYARD...

Huge Milk Truck Serves as a Portable Refrigerated Cooler with an A-P DEPENDABLE VALVE . . .

At one of the nation's busiest shipyards, a ten-ton truck from the nearby dairy drives in daily, plugs in a line to its inbuilt refrigerating system, and dispenses cool, fresh milk to the ship workers throughout a nine-hour day.

A-P Model 205 Thermostatic Expansion Valve. Capacity to 1 ton Freon.

Satisfactory Refrigeration is maintained all day long, despite continual opening of the cooler to service the smaller distributing trucks. The "A-P" Thermostatic Expansion Valve on this unit aids in maintaining peak cooling efficiency with a minimum of refrigeration loss from the extra long suction line required.

Perhaps we can help you — with your particular refrigerating problems. Ask for illustrated bulletins.

AUTOMATIC PRODUCTS COMPANY
2460 N. Thirty-Second Street Milwaukee 10, Wisconsin
Export Department — 13 East 40th Street, New York 16, New York

DEPENDABLE REFRIGERANT VALVES

SHOPPERS IN STORE DETECT NO VIBRATION FROM COMPRESSORS MOUNTED ON . . . KORFUND

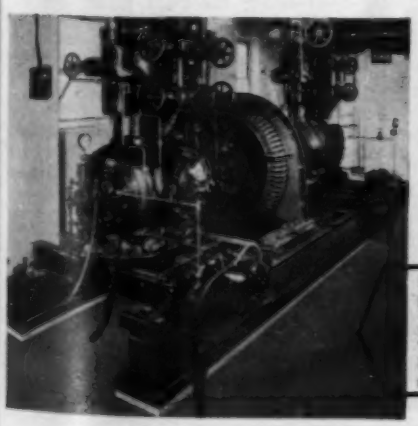
VIBRATION CONTROL

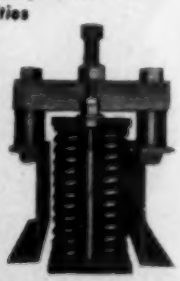
Although the two ammonia compressors required for air conditioning a large department store are installed on the fourth floor of the building, shoppers are not conscious of any noise or vibration. In fact, a disinterested party, asked if he could discover the location of the equipment by ear, was unable to do so from any of the store's shopping areas.

This is a typical example of an "impossible location" for heavy equipment made possible by Korfund. As shown in the photograph, the two compressors, arranged in duplex, are mounted on Korfund steel-spring isolators incorporated within a structural steel base. The isolators prevent the transmission of noise and vibration throughout the building structure.

If you have a vibration problem, write to us. Our engineers will be glad to give you the benefit of their broad experience.

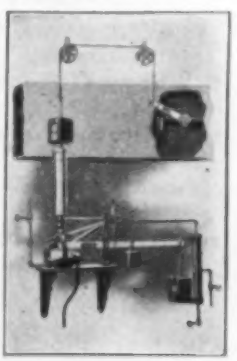
THE KORFUND COMPANY, INC.
48-36 Thirty-second Place, Long Island City 1, N. Y.
Representatives in Principal Cities





Left — The two compressors are installed on the fourth floor of the building. Above—Type of Korfund isolator used in this installation.

WHY
LEADING ENGINEERS
INSIST ON
LOCKE VALVES AND VALVE REGULATORS



Here is the most sensitive regulator ever built, the LOCKE HYDRAULIC REGULATOR (numbers 1 and 2). A movement of 2/1000 of an inch secures operation. Speed of operation is obtained and regulated by the discharge valve behind water motor.

★ ★ ★ ★

Traditional reliability, maintained for 75 years, establishes Locke as the leader in the design, manufacture and installation of regulators. Engineers who know, always specify LOCKE for standard and specialized duties. Locke is the absolute synonym for dependability in this critical and important phase of heating and ventilating. A Locke-trained engineer is at your service.

A catalog will be forwarded upon your request.

DIVISION OF THE H. T. WILSON MACHINE CO., INC.

LOCKE REGULATOR COMPANY

WALTER AND OSBORNE STREETS
SALEM, MASSACHUSETTS

MODEL REGULATORS · DAMPER REGULATORS · FAN ENGINE REGULATORS · BACK PRESSURE VALVES · BALANCED VALVES · ELECTRIC VALVES · REDUCING CONTROLS FLOAT CONTROLS · PILOT CONTROLS · PUMP GOVERNORS · VACUUM BREAKERS ENGINE STOPS · MASTER REGULATORS · OIL CONTROL VALVES · SOLENOID CONTROLS

WILLIAMS

SUPERIOR DROP-FORGED TOOLS

"VULCAN SUPERIOR"

CHAIN PIPE VISES

Above: "VULCAN SUPERIOR", with reversible jaws and adjusting handle on top. 2 sizes for pipe 1/8 to 4-1/2 inches.

At right: "VULCAN". 4 sizes for pipe 1/8 to 8 inches.

● Williams "Vulcan Superior" is an improved vise featuring "over-head" adjustment handle ... making it easier and faster to use. Jaws are reversible providing double the service of conventional vises. It has larger capacity too. Each vise takes pipe 1/2" larger than other chain pipe vises of similar size. Like all Williams tools it is fully guaranteed. Sold by Industrial, Plumbing & Oil Field Distributors everywhere.

J. H. WILLIAMS & CO., BUFFALO 7, N. Y.

● WPB . . . OPA . . . PAW . . . Etc. ●

OPA's Fuel Oil Ration Order

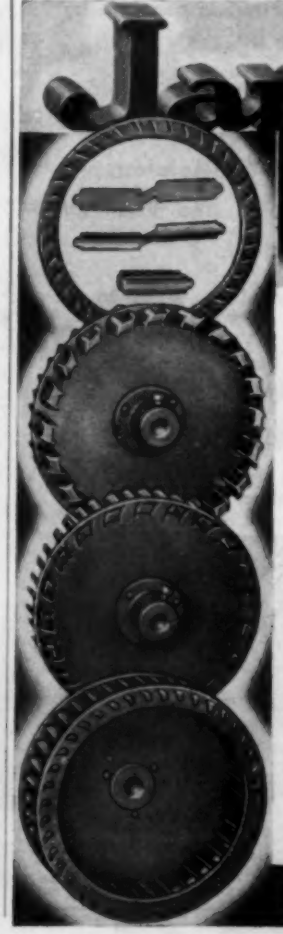
Amendment 47 to the OPA's revised ration order 12, effective March 2, provides that district directors must have the prior approval of the deputy administrator for rationing at the Washington office when declaring that there is an insufficient supply of alternate fuel, such as coal or wood, available in a given area. As in the previous regulation, when such a declaration is made certain restrictions on the issuance of fuel oil rations do not apply.

New definite value coupons in strip form and bearing serial numbers (to be called class 3A coupon sheets) have been designed to replace the present class 3 coupon sheets, according to *amendment 48*. It is expected that the new coupons will be available for board issuance early in April.

Amendment 49, effective March 3, allows issuance of a ration for fuel oil burning equipment for a commercial, industrial, or agricultural process if the standby facility is inadequate, or if the applicant must use fuel oil burning equipment in the event of a breakdown in the standby facility. Former regulations were that such a ration could not be issued unless the applicant obtained an exception from PAW to petroleum distribution order No. 13. It was thought desirable, OPA explains, to provide for issuance of rations to all proc-

Janette

Blower Wheels



5 to 12 in.

These Illustrations Show the Patented Construction of a Janette Wheel. The blades are formed in pairs for rigidity. The blade slots in the steel discs are die cut to ensure exact spacing of the blades. The hub is riveted to the back plate; then the blades are inserted into the slots. After the blades are spot welded to the back plate the tips are pressed thru the slots of the inlet disc, then rolled down against the disc.

The Inherent Spring of the Blades Keeps Them Tight.

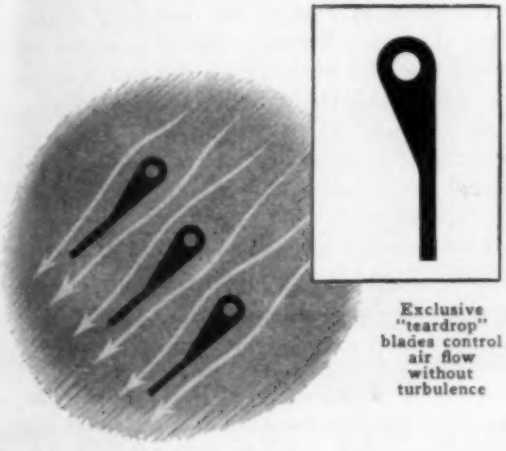
Because of This Construction, Janette Wheels have given over 19 years of universal satisfaction to internationally known manufacturers of coal stokers, blowers, ventilating equipment, air cooled engines, oil burners, superchargers, dust collectors, drying and fire detection apparatus. **It Will Pay You to Give Janette Blower Wheels a Trial!**

May We Send Literature?

Janette Manufacturing Company

556 W Monroe St Chicago 6

Quiet as a Whisper



Exclusive "teardrop" blades control air flow without turbulence

streamlined BLADES handle high-velocity air without grille noise

In buildings where air distribution requires high velocities, the modern answer is

Waterloo AIR DIFFUSERS

The exclusive *streamlined* blades on Waterloo registers and grilles direct the flow of air without noise or turbulence. And because each blade is individually adjustable, the air flow can be channeled in 1-2-3 or 4 directions at the same time—to fit the individual requirements of each room. Definite advantages, that make it worth while to specify Waterloo. And, post-war, Waterloo "grilles of the future" will be still further ahead of the parade.

Waterloo REGISTER CO.

Established 1902

Waterloo, Iowa **Seattle, Wash.**

Representatives in all principal cities

You'll have to *WATCH YOUR PENNIES* in the PEACETIME COMPETITION

With the coming of peace and a return to the American way of producing goods at a profit in highly competitive consumer markets you'll *have* to be certain that every step from initial blueprint and tool design, through the machining, stamping and assembly line, up to packaging and delivery is planned and executed with utmost efficiency and with the minimum of cost.

In the production of war munitions Oiljak has maintained an enviable record of production of intricate parts and on time deliveries, in accordance with strict Government inspection—and has actually reduced the estimated and approved cost, thus saving the Government considerable sums, by skillful planning and supervision of the work. These same skills in metal manufacturing, improving designs and reducing costs are available to manufacturers as they convert to peacetime merchandise. It may transmit your penny savings into dollar profits to confer with us on any metal manufacturing problem.

Machining • Stamping • Welding • Plating • Finishing • Assembling

The OILJAK Mfg. Co., Inc.

MONTCLAIR, N. J.
METAL MANUFACTURERS

THE JOB COMPLETE . . .
from blueprint to finished product

Now, a Better Way to lick trouble-making "WOBBLIES"

Users Report Bear Dy-Namic Balancing an Easier, Quicker and Inexpensive Operation! *This Free Bulletin Tells Why!*

Remarkable increases in the life of parts and machines, reductions in vibration and vibratory noise, and savings in maintenance are reported for equipment where rotating parts have been Dy-Namically Balanced!

Static Balance has been proven inadequate for today's machine speeds! Dy-Namic Balance, long known to engineers as important, is *now made practical* through the development of the Bear Dy-Namic Balancing Machines which

CUT TIME AND COST OF DY-NAMIC BALANCING!

For a full description of this fast growing industrial technique for which operators can be trained in a few hours, write for the BEAR DY-NAMIC BALANCING BULLETIN. Included is data on a complete line of machines for balancing everything from tiny armatures to railroad wheels! Address Bear Mfg. Co., Dept. HPV, Rock Island, Ill.

STATIC AND DY-NAMIC BALANCING MACHINES

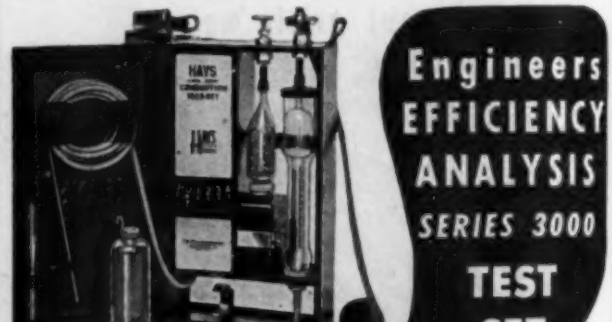
essors who need them for supplementary use or in the event of breakdowns in standby facilities. The unavailability of an alternate fuel or labor for the operation of a standby facility is not a basis for eligibility for these rations; in such contingencies application must still be made to PAW.

Amendment 50, effective March 15, provides a procedure for giving the consumer the proper amount of his fuel ration when his supplier has improperly detached coupons deposited by the consumer; that is, when the supplier has been enjoined from further violations of the ration order, making it impossible for him to make deliveries of fuel to the consumer without again violating the order. The amendment provides that a coupon sheet for the undelivered balance may be issued to the consumer after an accounting by the district director.

Amendment 51 provides that those fuel dealers who submitted the previous report on OPA form R-1198 in consolidated form by permission of the district director under amendment 40 may submit a consolidated report for the one due by April 25.

Steel Pipe Use by Utilities

The WPB's office of war utilities issued March 28 direction 4 to utilities order U-1 limiting the amount of steel pipe for maintenance and repair and for minor plant additions that utilities may schedule for delivery during the second quarter of 1945 to 20 per cent of steel pipe deliveries in all of 1944. An exception in the directive provides that utilities may schedule up to 10 tons of pipe without cut from last year's rate.

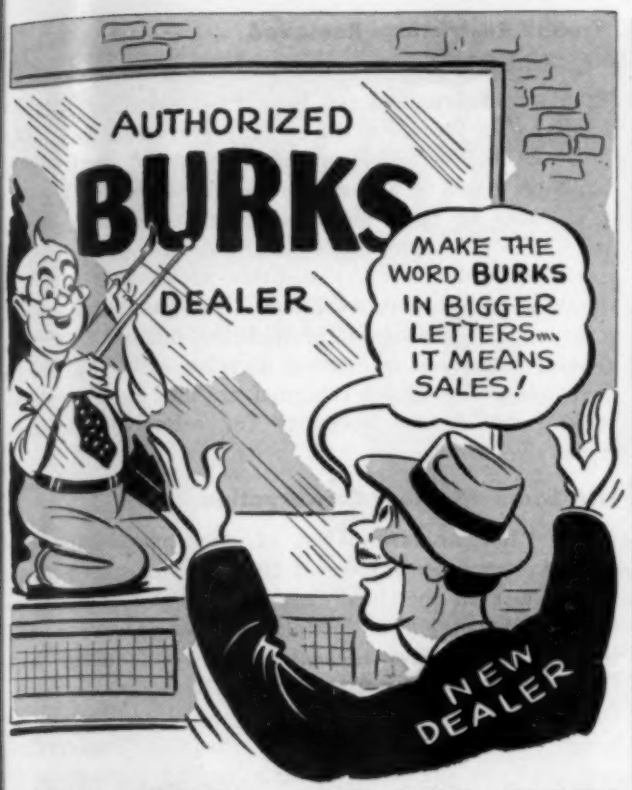


HAYS COMBUSTION SET

Portable
SIZE OF CASE 7¾"x5"x15" HIGH
WEIGHT 9 LBS.

For accurate, quick combustion analysis. Combines single unit gas analyzer with a diaphragm type draft gage and flue gas thermometer. Completely enclosed in steel case with leather handle, weight 9 lbs. Of particular benefit to service and heating engineers and installers of oil and gas burners, stokers, furances, and boilers. Full details in Bulletin 43-362.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.



DON'T WAIT—GET THE FACTS ABOUT A BURKS DEALERSHIP NOW—BE READY!

The war can't last forever and before you know it you'll be wanting to represent a good line of Water Systems.

You'll not want "what's left." You'll want the line that sells easiest and satisfies the user best. That means you'll want the BURKS Dealership.

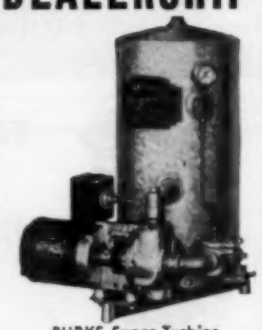
Right now is the time to get lined up. Distributors are busy appointing BURKS Dealers in all states now. If you want to represent BURKS Water Systems in the future, it's not too early to get the BURKS Dealer Proposition.

Engineering features no other system offers—satisfied owners—effective direct-to-prospect mail campaigns—local newspaper and steady magazine advertising—assure every BURKS Dealer a large volume of profitable post-war business. Why not be in on it?

Write us for complete details.

DECATUR PUMP CO.

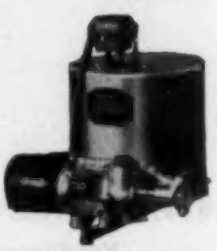
41 Elk St. Decatur 70, Ill.



BURKS Super Turbine Shallow Well System

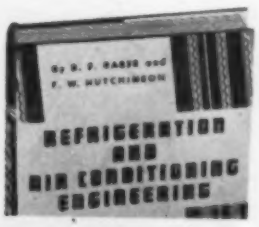
BURKS Vertical Educer Deep Well System

BURKS Heavy Duty Super Turbine—Large Capacity, pressures up to 150 pounds.



BURKS Condensation Return Units—both single and duplex types.

Know the theory . . . to solve the problem



REFRIGERATION AND AIR CONDITIONING ENGINEERING

By B. F. RABER, *Chairman, Division of Mechanical Engineering,* and F. W. HUTCHINSON, *Associate Professor of Mechanical Engineering; Both at the University of California.*

This new book tells how to solve many refrigeration and air conditioning problems by means of charts and graphs, without the use of advanced mathematics.

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"Freon" Restrictions Removed

Restrictions on the delivery and use of "Freon-12" (dichlorodifluoromethane) for air conditioning and certain types of refrigerating systems were removed April 2 by the WPB, which provided, however, that precedence be given to orders for F-12 gas for installation in systems of more essential users, who are not on list A of conservation order M-28. Action was taken by amending order M-28. Adequate supplies of the gas should continue to be available if the gas cylinders are returned with reasonable promptness, officials of WPB's general industrial equipment division said. Failure to have empty cylinders returned to the F-12 producer could result in the necessity for reimposing restrictions, they said.

FHA Loans for Heat Conservation

The FHA, in anticipation of short supplies of fuels during the winter months of 1945-46, announced March 24 renewal for the third year of its "summer plan" for insured-financing of installations to conserve fuel through prevention of heat losses. Under the plan, the first payment on FHA-insured loans made during the spring and summer for this purpose may be deferred until fall. Loans for heating conservation measures are available through lending institutions in amounts up to $2500 and are payable in monthly installments over as long as 36 months. The board of governors of the Federal Reserve System has exempted loans for these purposes from its restrictions on consumer credit.

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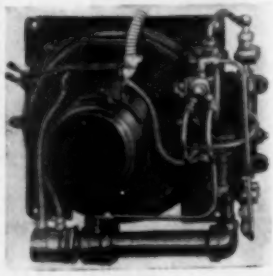

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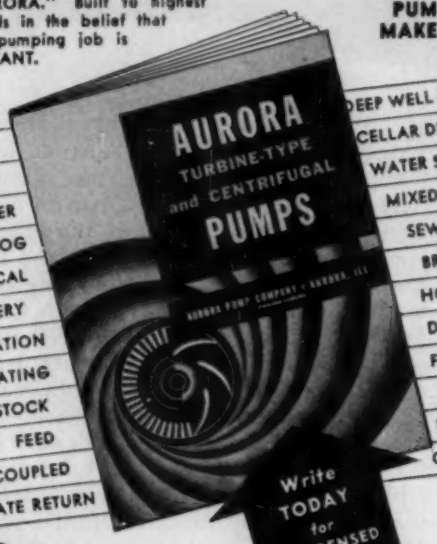

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NEW BOOKS & REPORTS

Pipe Sizes for Heating Systems; Piping Identification

The Heating, Piping & Air Conditioning Contractors National Association, 1250 Sixth Ave., New York 20, N. Y., has just published parts III and V of the fourth edition of its Engineering Standards.

Part III, Pipe Sizes and Design, is a 36 page booklet devoted to the sizing of pipes for steam heating and vapor systems, for gravity hot water heating systems, and for mechanically circulated hot water heating systems. In addition to the tables giving the necessary data for sizing pipe there are 10 pages of plates showing piping details, typical layouts for the piping of heating systems and proper hookups for unit heaters. These plates were developed in cooperation with the unit heater manufacturers' association. On one of the unit heaters a table is given for the ratings of low pressure float and thermostatic traps.

Part V, Graphical Symbols for Use on Drawings and Scheme for the Identification of Piping Systems, is a 20 page booklet of material developed under the procedure of the American Standards Association. In the section on graphical symbols the symbols used on drawings for piping systems, heating and ventilating systems, ductwork, and refrigerating systems are included. The identification of piping systems gives the scheme for identification by color and by legend.

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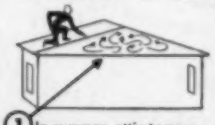
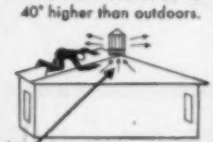


1 In summer, attic temperature often reaches 30° to 40° higher than outdoors.



2 Breidert Air-X-Hauster exhausts hot, stale air at the high point of roof, and...

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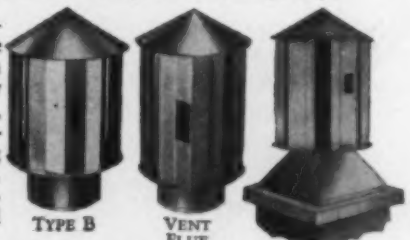

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MEETINGS & CONVENTIONS

Heating, Piping & Air Conditioning Contractors

The board of directors of the Heating, Piping & Air Conditioning Contractors National Association, 1250 Sixth Ave., New York 20, N.Y., has voted to cancel the 56th annual convention of the organization, which was to have been held in Cincinnati on May 21, 22, and 23. The action was taken to comply with the government request that meetings of more than 50, and not purely local in scope, be eliminated. Reports of the officers and committees will be published in the HPACCNA's Official Bulletin, starting in the May issue.

Connecticut Valley Section of ASRE

According to an announcement from Stanley R. Osborne (Chase Brass & Copper Co., Inc., Waterbury 91, Conn.), publicity committee chairman, the April 19 meeting of the Connecticut Valley section of the American Society of Refrigerating Engineers will be held in Springfield; F. M. MacDougall, chief engineer of the Alco Valve Co., is to speak on low temperature expansion valves.

* * *

Editor's note: Secretaries of local chapters and sections of engineering and contracting societies and associations are invited to send advance information on their meetings which will be of interest to readers of HPAC. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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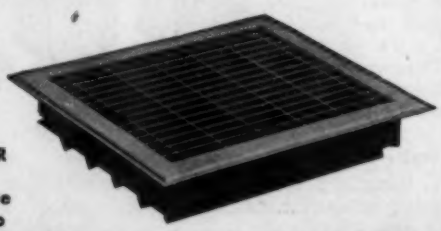

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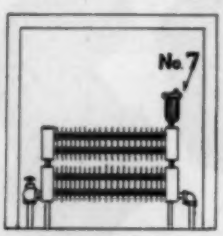

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